Mineral Development Division
Department of Mines and Energy
Government of Newfoundland and Labrador

GEOLOGY OF THE KING GEORGE IV LAKE MAP AREA (12A/4)

by

B.F. Kean

Report 83-4

St. John's, Newfoundland
1983

84- 3764 /

Mineral Development Division
Department of Mines and Energy
Government of Newfoundland and Labrador

GEOLOGY OF THE KING GEORGE IV LAKE MAP AREA (12A/4)

by

B.F. Kean

Report 83-4

St. John's, Newfoundland
1983

Editor R.V. Gibbons

Review Geologist Jane Murray

Copy Editors Phil Saunders
Doug Boyce

Text editing and typesetting

T. Parsons
B. French
D. Downey

Typing

W. Martin
E. Fost

Drafting Supervisor

K. Byrne

Drafting

D. Leonard
T. Paltanavage
A. Billard

Acknowledgements

This work was done under the Canada/Newfoundland Mineral Development Subsidiary Agreement (1976-1982) by contributions from the Government of Newfoundland and Labrador (10 percent) and from the Departments of Regional Economic Expansion (45 percent) and Energy, Mines and Resources (45 percent) of the Government of Canada.

Publications of the Mineral Development Division are available through the Publications and Information Section, Mineral Development Division, Department of Mines and Energy, P.O. Box 4750, St. John's, Newfoundland. A1C 5T7
Telephone: (709) 737-3159
Telex: 016-4724

Table of Contents

	PAGE
ABSTRACT	v
INTRODUCTION	
Location and Access	1
Previous Work	1
Present Investigation	1
Physiography	1
Regional Setting	2
GENERAL GEOLOGY	4
CORMACKS LAKE COMPLEX	
Definition, Division and Distribution	6
Age and Correlation	6
Unit 1	6
KING GEORGE IV LAKE COMPLEX (UNITS 2, 3, 4)	
Definition, Division and Distribution	9
Age and Correlation	11
Unit 2	11
Unit 3	12
Unit 4	14
Structure and Metamorphism	15
VICTORIA LAKE GROUP (UNITS 5, 6, 7)	
Definition, Division and Distribution	15
Age and Correlation	16
Mafic Pillow Lava (Unit 5)	16
Interbedded Mafic and Felsic Tuff (Unit 6)	18
Intermediate and Felsic Volcaniclastic Rocks (Unit 7)	19
Structure and Metamorphism	23
BAY DU NORD GROUP (?) (UNIT 8)	
Definition, Division and Distribution	23
Age and Correlation	24
Sedimentary Rocks and Schists (Subunits 8a and 8b)	24
Paragneiss and Amphibolite (Subunits 8c and 8d)	26
Migmatite (Subunit 8e)	30
ROGERSON LAKE CONGLOMERATE (?) (UNIT 9)	
Definition and Distribution	34
Age and Correlation	34
Unit 9	34
Deformed Granite and Granodiorite (Unit 10)	36
Lloyds River Intrusive Suite (Unit 11)	39
Granodiorite (Unit 12)	42
Buck Lake Granite (Unit 13)	43

Gabbro and Diorite (Unit 14)..... 46

WINDSOR POINT GROUP (Unit 15) 48
Definition, Division and Distribution..... 49
Unit 15..... 58

Granite (Unit 16)..... 60

Biotite Gabbro-norite (Unit 17).... 61

STRUCTURE..... 61
Pre-Ordovician (?) Structures..... 62
Acadian Structures..... 63

METAMORPHISM..... 64

TIMING OF EVENTS..... 64

MINERALIZATION..... 65

ACKNOWLEDGEMENTS..... 65

REFERENCES.....

List of Figures

		PAGE
Figure 1:	Tectonostratigraphic zones of the Newfoundland Appalachians (after Williams, 1978).....	2
Figure 2:	Modified tectonostratigraphic zones of the Newfoundland Appalachians.....	3
Figure 3:	Generalized geological map of the King George IV Lake area.....	5

List of Tables

Table 1:	Table of formations for the King George IV Lake map area.....	7
Table 2:	Modal composition of intrusive rocks in the map area.....	38

List of Plates

Plate 1:	Deformed granite of the Cormacks Lake complex, Flat Bay Brook. Note the main fabric is transposed by a strain-slip cleavage....	10
Plate 2:	Refolded fold in paragneiss of the Cormacks Lake complex, north of King George IV Lake.....	10
Plate 3:	Coarse grained, melanocratic gabbro with thin diabase dike, King George IV Lake complex, north of Boogie Lake.....	12
Plate 4:	Pillow lava with minor interpillow material, King George IV Lake complex, east of King George IV Lake.....	14
Plate 5:	Lithic and quartz clasts in volcaniclastic graywacke of the Victoria Lake Group, east of the Burgeo Road.....	22
Plate 6:	Quartz-feldspar crystal tuff of the Victoria Lake Group, east of Burgeo Road.....	22
Plate 7:	Interbedded siltstone argillite and sandstone of the Bay du Nord (?) Group, Victoria Lake. Note granite dike under the hammer....	25
Plate 8:	Staurolite, with quartz-mica inclusion trails, forming augen in schists of the Bay du Nord Group, south of Victoria River.....	27
Plate 9:	Garnet with quartz inclusion trails and corroded margins which forms augen in mica schists of the Bay du Nord Group, south of Victoria River.....	27
Plate 10:	Psammitic and semipelitic metasediments of the Bay du Nord Group, Buck Lake Quarry, Burgeo Road. Intruded by Buck Lake Granite. Note veinlets and stringers of granite.....	28

Plate 11: Migmatite, Bay du Nord Group, Burgeo Road. Biotite rich paleosome in a granodioritic neosome..... 32

Plate 12: Angular and partially resorbed blocks of paragneissic paleosome float in a nebulitic leucosome of granodiorite, Bay du Nord Group, west of Princess Lake..... 32

Plate 13: Highly deformed conglomerate of Unit 9, Victoria Lake..... 35

Plate 14: Cataclastic fabric developed in granite of Unit 10, Burgeo Road. 37

Plate 15: Folded biotite granite dike intruding the megacrystic Buck Lake Granite (top right) and metasediments of the Bay du Nord Group, Buck Lake Quarry, Burgeo Road. Pencil parallels an axial planar schistosity..... 44

Plate 16: Crossbedded sandstone, Windsor Point Group, quarry on Burgeo Road at north end of map sheet..... 51

Plate 17: Laharic flow, Windsor Point Group, east side of King George IV Lake..... 51

Plate 18: Interbedded gray sandstone and fossiliferous black siltstone, Windsor Point Group, approximately 1 km upstream from King George IV Lake on Princess Lake Brook. Top is towards left..... 54

Plate 19: Cobble to boulder orthoconglomerate of the Windsor Point Group, northwest of Princess Lake..... 54

Plate 20: Flow folded, flow-banded, hematite-rich, welded rhyolite tuff, Windsor Point Group, Burgeo Road. Light areas are recrystallized (felsite) glass and pumice..... 56

Plate 21: Ruled pumice lapilli in crystal-lithic lapilli tuff of the Windsor Point Group, ponds east of Burgeo Road..... 57

Plate 22: Clast of quartz (light) intergrown with alklai feldspar in sandstone of Windsor Point Group, same locality as Plate 18..... 57

Plate 23: Albite-perthitic microcline, Unit 16b..... 60

ABSTRACT

The King George IV Lake map area is located in southwestern central Newfoundland. It is underlain by six main groups of rocks: the Cormacks Lake complex, the King George IV Lake complex, the Victoria Lake Group, the Bay du Nord Group, the Windsor Point Group and a variety of igneous intrusions including the Lloyds River Intrusive Suite and the Buck Lake Granite. The Cormacks Lake complex, underlying the northwest part of the map area, is a sequence of paragneiss, amphibolite and orthogneiss with strong northwest structural trends. It is interpreted to be the oldest unit and possibly of Grenvillian age. It is intruded by the Lloyds River Intrusive Suite. The King George IV Lake complex, consisting of gabbro, sheeted dikes and pillow lava, is in fault contact with the Ordovician island arc volcanic sequences of the Victoria Lake Group. It is interpreted to form an oceanic basement to the Victoria Lake Group and the laterally equivalent metasedimentary and metamorphic rocks of the Bay du Nord Group. These sequences were deformed, generally polydeformed, metamorphosed in greenschist to amphibolite facies conditions, and intruded by gabbroic to granitic rocks of the Lloyds River Intrusive Suite and the Buck Lake Granite prior to the deposition of the Lower Devonian Windsor Point Group. The Windsor Point Group consists of subaerial volcanics and fluviatile sediments and is restricted to a narrow zone along a splay of the Cape Ray Fault. A number of small granitic and gabbroic bodies were subsequently emplaced. Late folding, tilting and faulting affected all of these rocks.

It is probable that the entire sequence of post-Cormacks Lake complex tectonic events occurred between the Middle Silurian and Late Devonian and are thus all attributable to the Acadian orogeny.

Disseminated pyrite and minor chalcopyrite and sphalerite occur in the volcanic rocks of the Victoria Lake Group. Galena, sphalerite and gold mineralization were found in quartz veins in a boulder of granite belonging to the Lloyds River Intrusive Suite, in the Princess Lake area. Molybdenite-bearing granite float occurs west of Rocky Ridge Pond.

INTRODUCTION

Location and Access

The King George IV Lake map area is located in southwestern central Newfoundland and is bounded by latitudes 48° 00' N and 48° 15' N and by longitudes 57° 30' W and 58° 00' W.

There are no permanent settlements in the area, although hunting and fishing cabins and lodges are maintained on the larger ponds and lakes. The newly constructed, all-weather gravel road to Burgeo (Route 480) runs approximately north-south through the center of the map area; it links Burgeo to the Trans Canada Highway near the Stephenville access road. Most of the area is readily accessible only by aircraft. A number of large ponds and lakes scattered throughout the area provide easy access by float plane. King George IV Lake and Spruce Pond are both accessible by canoe from the Burgeo road, with extensive portaging. Victoria River is easily navigable by canoe along the section from Peter Strides Pond to a point approximately 3 km above Victoria Lake.

Previous Work

The King George IV Lake area was previously mapped by Riley (1957) at 1:253,440 scale (1" = 4 miles) as part of a regional mapping program of the Red Indian Lake (west half) map area by the Geological Survey of Canada. He considered most of the sedimentary and volcanic rocks that lie on the King George IV Lake map sheet to be of probable Ordovician age; he assigned them to the Strides Group which he correlated on the basis of lithologic similarity with the Buchans Group to the northeast. He considered the Buchans Group to be similar to the Exploits Group as defined by Heyl (1936) in central Notre Dame Bay. Red and gray crossbedded sandstone, graywacke and argillite with associated terrestrial basic and felsic volcanics were correlated by Riley (1957) with the Bay du Nord Group of Cooper (1954). On the basis of this correlation, Riley considered the former sequence to be Devonian in age. The intrusive rocks were considered Devonian or earlier in age on the basis of cross-cutting relationships and the presence of the intrusive rocks in detritus of Carboniferous sedimentary rocks.

DeGrace (1973) mapped the area in the vicinity of King George IV Lake at a scale of 1 inch to 1 mile for the Newfoundland Department of Mines and Energy. He considered the fluviatile sediments and subaerial volcanics to be of Carboniferous age. Parts of the area were also mapped by ASARCO (Swanson, 1952-1960) and Hudson's Bay Oil and Gas Company (Sterenberg, 1979). Smyth (1979) produced a 1:50,000 scale compilation of the geology of the area based on his own reconnaissance mapping as well as data supplied by the Buchans Mining Company (ASARCO).

Present Investigation

This report is the result of field work carried out during the 1980 field season by a five-man party (two mapping teams) under the supervision of the author. It forms part of a 1:50,000 scale mapping project in central Newfoundland that began in 1975.

Air photographs at 1:12,500 scale (color) and 1:15,840 scale (black and white) were used for mapping, and the data were subsequently compiled on 1:50,000 scale NTS map sheets. Data provided by mining companies were also used for the report.

Physiography

Most of the King George IV Lake area is a barren, hummocky upland with an elevation of 350 to 400 m. High hills, which are probably monadnocks, stand above this level to a maximum height of 552 m. Three major river systems, the Lloyds, Victoria and Burnt Pond Rivers, drain the map area and flow northeast.

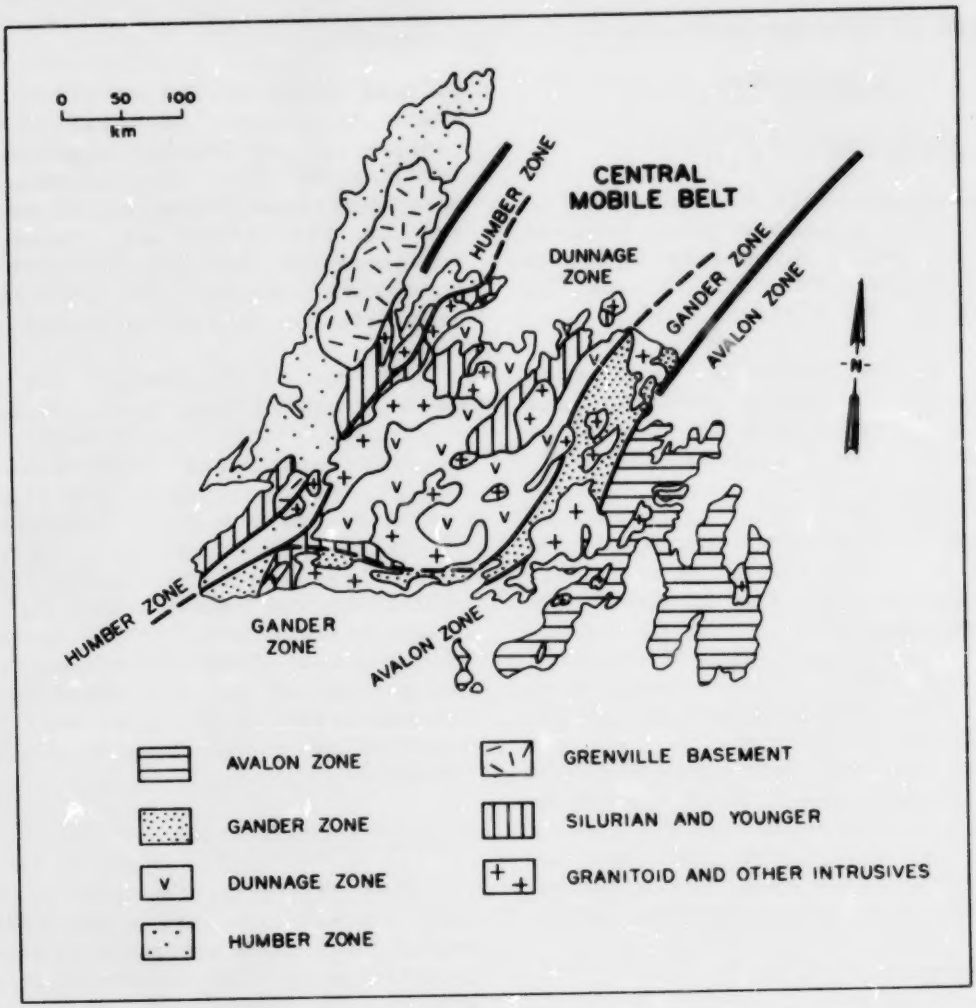


Figure 1: *Tectonostratigraphic zones of the Newfoundland Appalachians (after Williams, 1978).*

The Lloyds River feeds the Red Indian Lake - Exploits River system and the Victoria River flows into Victoria Lake, while to the east of the map area the Burnt Pond River has been diverted to flow into the Bay D'Espoir hydroelectric system. The topographic grain and main drainage pattern predominantly reflect the bedrock structures, although many of the smaller lakes and ponds show no discernible geological control. Scrub spruce and tuckamore are common along streams, gullies and slopes of hills. Stands of fir and spruce are present in the large protected valleys.

A mantle of Pleistocene till of variable thickness covers much of the area. Eskers are locally well developed. The prominent direction of ice movement was from north to south (Murray, 1955).

Regional Setting

The King George IV Lake map area lies at the southern extremity of the Central Paleozoic Mobile Belt. It is in the area where the Gander, Humber and Dunnage tectonostratigraphic zones (Williams, 1978, 1979) were previously interpreted to be juxtaposed (Figure 1). The juxtaposition of these zones was postulated to have occurred along the Cape Ray Fault (Brown, 1973). However, recent studies in southwestern and south-central Newfoundland have led to major revisions in this interpretation

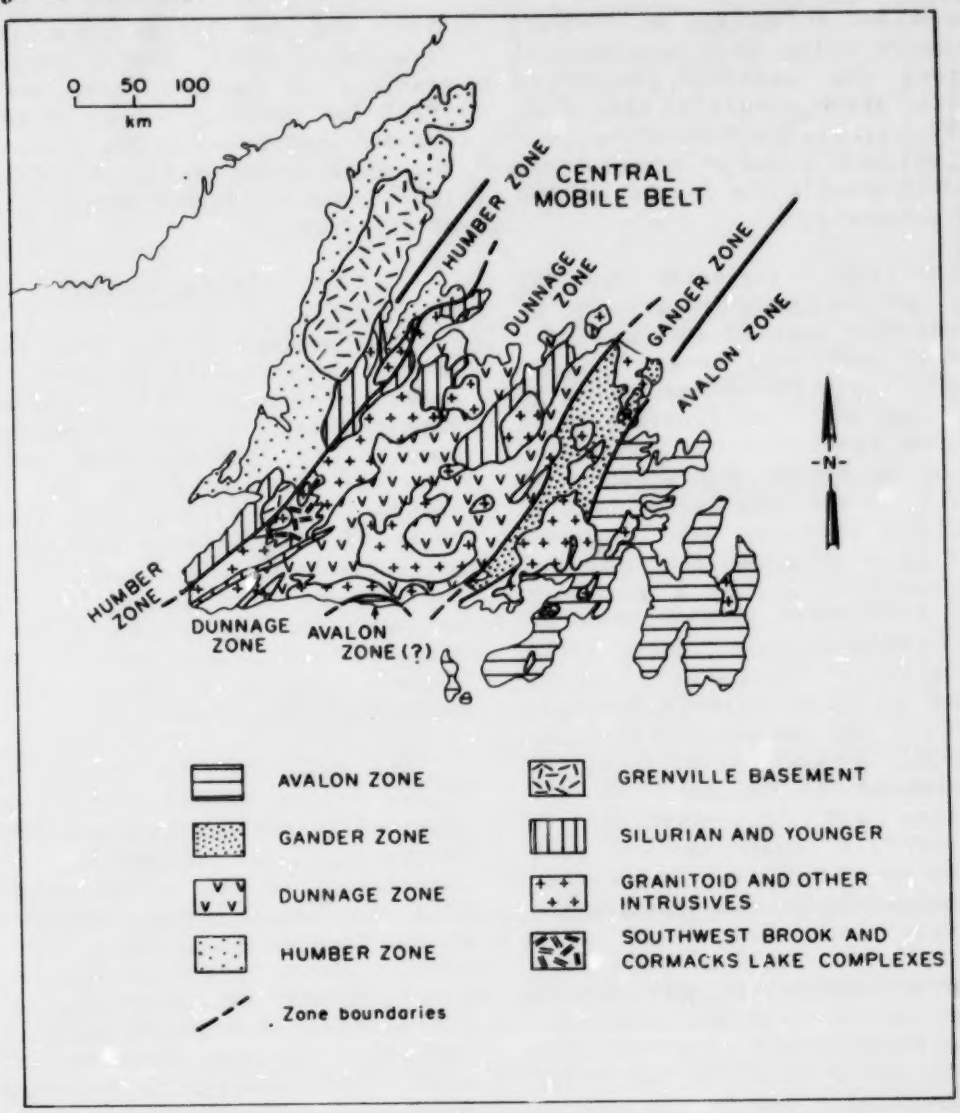


Figure 2: *Modified tectonostratigraphic zones of the Newfoundland Appalachians.*

of the southern end of the Newfoundland Appalachians (Figure 2). For example, Chorlton (1980b) demonstrated that much of the metamorphic sequence previously assigned to the Gander Zone in southwestern Newfoundland is not Precambrian basement but is instead the highly deformed and metamorphosed equivalent of Ordovician island arc type rocks of the La Poile and Bay du Nord Groups. The present study has demonstrated that the Bay du Nord and La Poile Groups of southern Newfoundland are continuous into central Newfoundland. The Dunnage Zone has no southerly termination as suggested by Williams (1978, 1979) and Williams et al. (1972, 1974), but extends from Notre Dame Bay to the south coast. The Bay du Nord and La Poile Groups are herein interpreted as lateral equivalents of the Victoria Lake Group and equivalent rocks of central and northeastern Newfoundland, and of the Baie d' Espoir Group (Chorlton, 1980b) of southeastern Newfoundland. It is now generally accepted that these volcanic-sedimentary sequences rest, at least in part, on oceanic crust and are thus

ensimatic island arc rocks. An eastward and southward onlap onto continental crust along the eastern margin of Iapetus is also possible (Swinden, 1982). Fluviatile sedimentary and subaerial volcanic rocks of Devonian age unconformably overlie the island arc and ophiolite sequences.

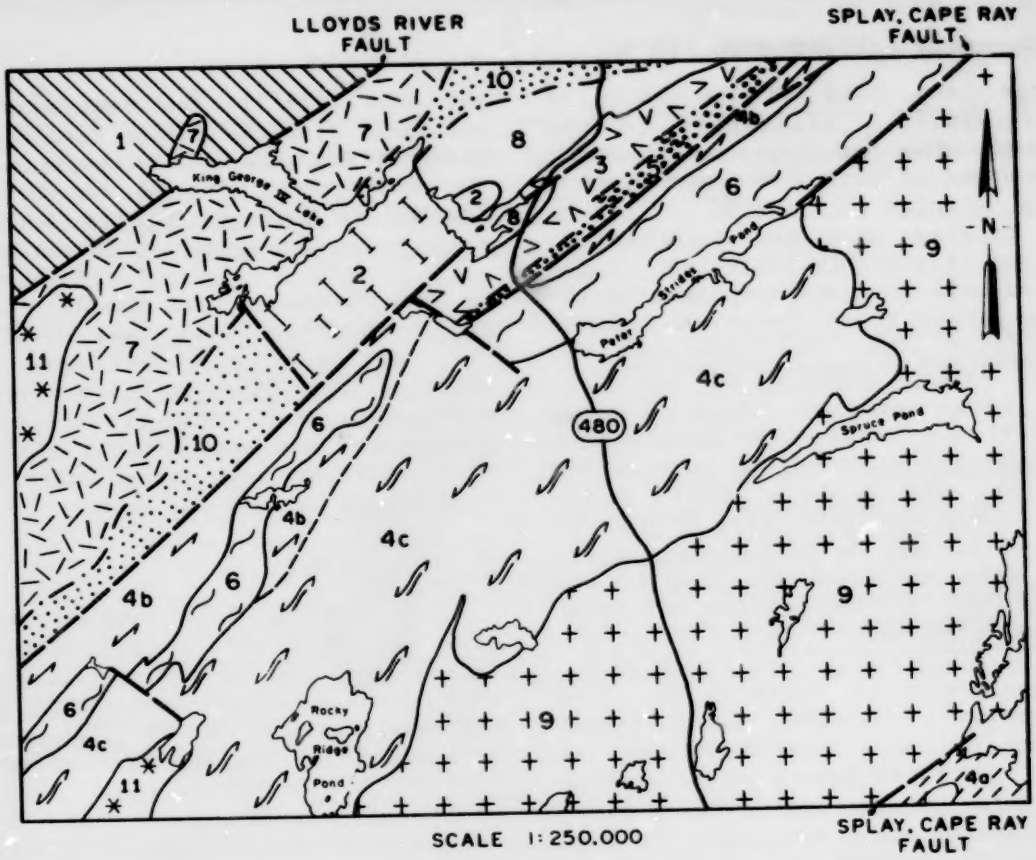
Chorlton (1980b) suggested that the structural and metamorphic history of rocks immediately west of the northeast trending Cape Ray Fault (e.g. Keepings Gneiss), previously thought to belong to the Humber Zone and to be Precambrian in age, was not substantially different from that of the Bay du Nord Group south of the fault. In the King George IV Lake map area, the Cormacks Lake complex, lying west of a splay of the Cape Ray Fault, is characterized by a prominent northwest structural trend that is considered pre-Ordovician. These rocks were tentatively interpreted to be Humber Zone rocks of Grenvillian age, remobilized in the Paleozoic (Herd and Dunning, 1979). However, these rocks are here considered to be part of the Dunnage Zone and form part of an agmatite terrain that is in part represented by the Middle Ordovician Southwest Brook Complex and possibly the Lloyds River Intrusive Suite. The Southwest Brook complex contains inclusions of ophiolitic gabbro and harzburgite, schists and gneisses. The Cabot (Long Range) Fault separates this terrain from the Grenvillian age Steel Mountain Anorthosite and is interpreted as the boundary between the Dunnage and Humber Zones (Figure 2).

The Cape Ray Fault bifurcates immediately south of the King George IV Lake map area and both splays transect the map area. It probably represents a major and long-lived structure where obduction or thrusting of ophiolitic rocks occurred for a small part of its length. The northerly extensions or splays of this fault generally occur within rocks of the same age and tectonic histories. Fault and shear zones along Lloyds River valley (Kean, 1977) and Red Indian Lake (Kean and Jayasinghe, 1980, 1982), cataclastized granites in the Star Lake area (Kean, 1979) and the King George IV Lake area, and deformed Devonian age granites along the south shore of Victoria Lake (Kean, 1977) probably formed along late splays of the fault.

GENERAL GEOLOGY

The geology of the King George IV Lake area is readily divisible into six main elements: (1) gneiss and amphibolite of the Cormacks Lake complex, (2) gabbro, dikes and pillow lava of the King George IV Lake complex, (3) volcanic and sedimentary rocks of the Victoria Lake Group, (4) metasedimentary and migmatitic rocks of the Bay du Nord Group, (5) Devonian volcanic and sedimentary rocks of the Windsor Point Group, and (6) intrusive rocks. Figure 3 is a simplified geological map of the area.

The Cormacks Lake complex (Unit 1, Figure 3), an assemblage of paragneiss, amphibolite and deformed granite in the northwest corner of the map area, is interpreted as the oldest unit in the area. Gabbro, diabase dikes and mafic pillow lava of the King George IV Lake complex (Unit 2) are interpreted to be oceanic crust and are considered to be correlative to the Annieopsquotch ophiolite complex (Dunning and Herd, 1980). This complex is interpreted as forming the oceanic basement to island arc type volcanic rocks of the Victoria Lake Group (Unit 3) and sedimentary and metasedimentary rocks of the Bay du Nord Group (Unit 4). The Victoria Lake Group in the area consists mainly of volcanic rocks and is traceable northeastward along strike into the Middle Ordovician and older Victoria Lake Group (Kean, 1977). The part of the Bay du Nord Group exposed in the area forms an epiclastic volcanic and sedimentary sequence which is progressively metamorphosed and migmatized to the south. It is considered to be a possible lateral equivalent of the volcanic rocks of the



GRANITE: *Red and pink granite*

WINDSOR POINT GROUP: *Red sandstone, siltstone and conglomerate; gray graywacke, black siltstone; mafic and felsic subaerial volcanics*

BUCK LAKE GRANITE: *K-feldspar megacrystic granite, minor equigranular granite and granodiorite*

BOOGIE LAKE GABBRO: *Gabbro, diorite, granodiorite and granite*

LLOYDS RIVER INTRUSIVE SUITE: *Gabbro, quartz diorite, granodiorite, tonalite and granite*

GRANITE: *Mylonitized red granite and gray granodiorite*

ROGERSON LAKE CONGLOMERATE: *Deformed polymictic conglomerate and minor sandstone*

BAY DU NORD GROUP: **4a,** *Siltstone, argillite and minor sandstone;* **4b,** *mica schist, psammitic paragneiss and amphibolite;* **4c,** *granodioritic and tonalitic migmatite*

VICTORIA LAKE GROUP: *Interbedded felsic and mafic tuffs, epiclastic rocks, minor pillow lava and agglomerate*

KING GEORGE IV LAKE OPHIOLITE COMPLEX: *Gabbro, sheeted dikes and basaltic pillow lava*

CORMACKS LAKE COMPLEX: *Paragneiss, amphibolite and deformed granite*

Figure 3: *Generalized geological map of the King George IV Lake area.*

Victoria Lake Group on the basis of stratigraphic relationships to the northeast (Kean and Jayasinghe, 1980). Conglomerate of Unit 5 is considered to overlie unconformably the Victoria Lake Group locally (Kean and Jayashinghe, 1980) and is possibly equivalent to the Rogerson Lake Conglomerate. The fossiliferous upper Lower Devonian Windsor Point Group (Unit 10) comprises the youngest layered rocks in the map area. These rocks outcrop in a narrow, northeast-southwest trending belt underlying the northwestern part of the map area. The Windsor Point Group unconformably overlies King George IV Lake complex, Bay du Nord Group, Lloyds River Intrusive Suite and Boogie Lake gabbro. Contact modification by later faulting is common.

Intrusive rocks range in age from pre-Devonian to possibly Carboniferous and range in composition from gabbro to granite. The rocks that are demonstrably pre-Devonian in age are the cataclastized granites and granodiorites of Unit 6 and gabbro, diorite and granite of the Lloyds River Intrusive Suite (Unit 7). Clasts of similar lithologies occur in conglomerate of the Windsor Point Group. Granodiorite and granite (Unit 9) and the Boogie Lake gabbro and diorite (Unit 8), although undated, are tentatively considered pre-Windsor Point Group in age. Essentially undeformed pink to red granite (Unit 11) and biotite gabbro-norite are interpreted to be Devonian or younger in age.

The rocks in the map area vary from undeformed to variably deformed, most are polydeformed. The regional metamorphism varies from subgreenschist to amphibolite facies.

CORMACKS LAKE COMPLEX

Definition, Division and Distribution

The complex was informally named and described by Herd and Dunning (1979) as an assemblage of foliated granite, paragneiss and amphibolite exposed in the southwestern part of the Puddle Pond map area (12A/5). The same assemblage continues from the Puddle Pond map area along strike into the northwest part of the King George IV Lake map area. The complex is bordered to the south and east by younger granitoid intrusions.

The Cormacks Lake complex in the Puddle Pond map area, was divided by Herd and Dunning (1979) into three lithologically distinct units consisting essentially of foliated granite, paragneiss and amphibolite. The same three units are also recognizable in the King George IV Lake map area.

Age and Correlation

The Cormacks Lake complex has not been radiometrically dated; however, a lithological and structural correlation with the Grenvillian Long Range Gneiss has been suggested (Herd, 1978; Herd and Dunning, 1979). Because the geological history of the metamorphic rocks of southwest Newfoundland is poorly understood, it is not presently possible to be certain of the age of these rocks. In the present map area, the Cormacks Lake complex is the only unit with an early (*i.e.* predating the regional northeast fabric) northwest trending structural fabric.

Unit 1

Definition, division and distribution

Unit 1 consists of paragneiss, amphibolite and deformed granite exposed in the northwest corner of the map area. It is not possible to map separate units of amphibolite and paragneiss at the present scale of mapping. On the accompanying map, the predominance of one rock type over the other at each outcrop is indicated by letters keyed to the legend. The unit is best exposed in the hills north and northwest of King George IV Lake.

Subunit 1a consists of amphibolite and interlayered mica schist, biotite-garnet (+ hornblende) gneiss and minor calc-silicate rocks (Table 1). Semi-

Table 1: Table of formations for the King George IV Lake map area.

EARLY DEVONIAN AND YOUNGER	BIOTITE GABBRONORITE (Unit 17): medium to coarse grained, equigranular gabbronorite.	
	No contact (intrusive into Bay du Nord Group)	
	GRANITE (Unit 16): pink to red granite.	
	No contact (intrusive into Bay du Nord Group and Lloyds River Intrusive Suite)	
	WINDSOR POINT GROUP (Unit 15): sandstone, conglomerate, mafic and felsic volcanics.	
MIDDLE ORDOVICIAN TO SILURIAN	*Unconformity (unconformably on King George IV Lake ophiolite complex, Bay du Nord Group, Unit 14 and Lloyds River Intrusive Suite)*	
	GABBRO AND DIORITE (Unit 14): medium to coarse grained gabbro, diorite and minor granite.	
	No contact (intrusive into King George IV Lake ophiolite complex and Victoria Lake Group)	
	BUCK LAKE GRANITE (Unit 13): K-feldspar porphyritic granite and granodiorite.	
	Intrusive into Unit 12, Bay du Nord Group and Unit 10	
	GRANODIORITE (Unit 12): biotite granodiorite and tonalite.	
	No contact (intrusive into Bay du Nord Group)	
	LLOYDS RIVER INTRUSIVE SUITE (Unit 11): gabbro, diorite, tonalite, granodiorite and granite.	
	No contact (intrusive into Cormacks Lake Complex)	
	DEFORMED GRANITE AND GRANODIORITE (Unit 10): red granite and gray granodiorite.	
	No contact (intrusive into Bay du Nord Group)	
	CONGLOMERATE (Unit 9): conglomerate and sandstone.	
	Unconformity (faulted)	
MIDDLE ORDOVICIAN AND OLDER	VICTORIA LAKE GROUP: Unit 7 : felsic volcanics and epiclastics. Unit 6: interbedded mafic and felsic tuff. Unit 5: predominantly pillow lava.	BAY DU NORD GROUP (Unit 8): metasedimentary rocks and migmatite.
	Fault contact (assumed originally conformable)	
EARLY ORDOVICIAN	KING GEORGE IV LAKE OPHIOLITE COMPLEX	Unit 4: pillow lava. Unit 3: diabase dikes. Unit 2: gabbro and diabase.
	No contact	
PRE-ORDOVICIAN (?)	CORMACKS LAKE COMPLEX (Unit 1): paragneiss, amphibolite and foliated granite.	

pelitic gneiss and quartzite with minor amphibolite and calc-silicate rocks constitute subunit 1b. These rocks are intruded by a foliated, medium grained, red, biotite granite of subunit 1c in the northwestern extremities of the map area.

Lithology

The gneisses and schists are pale gray and exhibits a thin (1 to 5 mm wide) banding produced by alternating biotite-rich and quartzofeldspathic layers. Garnet is locally common. The gneiss is rusty weathering in places, probably due to the presence of magnetite and pyrite. The quartzite is fine to medium grained, pale gray and generally massive. It occurs as <15 cm to 1 m thick bands interlayered with amphibolite 0.5 m thick. The amphibolite is medium grained, greenish gray and in places contains a 2-5 mm thick layering of dark amphibole and whitish to reddish quartzofeldspathic bands. The amphibole crystals range up to 4 cm in length, locally form rosettes, and define an S-fabric. Rare anthophyllite- and plagioclase-rich rocks interlayered with the paragneisses may represent calc-silicate bands. The foliated granite is red to pink, medium grained, equigranular and cut by thin (<1 m in width) diabase dikes that have been deformed and boudinaged.

In places, extensive granitic tongues and partial melting and/or remobilization have imparted a banded, migmatite-like texture to the paragneiss. Hornfels is developed adjacent to intrusives. The layering in all of the above rocks is cut by granite veins, aplite, diorite, and metadiabase which have been subsequently foliated, boudinaged and folded. Undeformed muscovite $\pm$ garnet granite sheets and pegmatites also intrude the complex.

Petrography

The biotite gneiss has a poorly developed banding defined by the metamorphic segregation of the minerals into biotite-hornblende and quartzo-feldspathic layers. Quartz occurs as crystals up to 3 mm in size with undulose extinction. The crystals are elongated with irregular and sutured grain boundaries, and define a foliation. Oligoclase and andesine feldspar form equigranular and equidimensional crystals with grain size up to 2 mm. In places recrystallization has occurred and polygonal grain boundaries have been developed. Rare, small, disoriented to oriented biotite flakes, up to 1 mm but generally about 0.3 mm, occur in these bands. Pseudomorphs of either cordierite or andalusite, consisting of muscovite, sericite and fine grained alteration products (pinite?) occur locally.

The mafic bands consist mostly of brown biotite and minor green hornblende that in places define a foliation, and minor quartz and feldspar. The biotite crystals are generally less than 0.5 mm but locally up to 3 mm in width. In places the hornblende is rimmed or replaced by biotite. Chlorite, in places with anomalous purplish-blue interference color, is common as an alteration of biotite; epidote and minor calcite are also present. Late euhedral garnets are dispersed throughout the rock.

The quartzites consist essentially of quartz and andesine with a recrystallized granoblastic texture. The grain size varies from 0.2 to 1 mm. Minor hornblende and actinolite (tremolite) are also present.

The amphibolites consist of plagioclase (An_{40}), green, pleochroic hornblende, minor quartz and feldspar and rare garnet. The grain size in the amphibolite is up to 1 mm, but is generally less than 0.5 mm. A micro-banding is defined by hornblende and minor quartz and feldspar and quartzo-feldspathic segregations. A crude foliation is defined by the preferentially oriented hornblende, by actinolite-tremolite layers and by elongate quartz. The feldspars commonly

form stumpy, rectangular crystals. Sulfides and magnetite are present as accessory minerals. However, the amphibolites have mostly recrystallized to an equigranular, granoblastic-polygonal texture, probably as a result of contact metamorphism related to the intrusion of Unit 11.

The foliated granites consist of quartz, microcline (+ orthoclase) and sodic plagioclase. Biotite and rare hornblende are the major phases and in places are altered to chlorite. The biotite flakes are subhedral, 0.2 to 1 mm long and define a weak foliation. The quartz displays undulose extinction, is sutured and embayed, contains subgrain boundaries and forms anhedral grains up to 3 mm. The plagioclase generally forms stumpy, rectangular crystals less than 0.5 mm long. The K-feldspar forms anhedral interstitial grains of about 1 mm. The rock is nearly equigranular due to recrystallization.

Structure and metamorphism

Evidence of polyphase deformation is widespread in Unit 1. For example, in outcrops of the foliated granite, a north-northwest trending foliation has been transposed by a northeasterly trending strain-slip cleavage (Plate 1). In the gneisses, Type 1 and Type 3 interference patterns (Ramsay, 1967) are common (Plate 2) and the northwest trending banding and foliation, and early isoclines within the banding, have been folded around northeast trending axes. These northeast trending folds are generally tight to isoclinal in shape; they have a northeast striking axial planar foliation, and plunge to both the northeast and southwest. The foliation is folded openly around northwest trending, steeply, generally southeast plunging fold axes. These northeasterly trending structures and the late northwest structures are tentatively correlated with the regional Acadian structures developed in the other units in the map area.

Rocks of the Cormacks Lake complex in the Puddle Pond area, immediately north of the present map area, are characterized by middle to upper amphibolite facies assemblages of cordierite, garnet, sillimanite and gedrite in the paragneiss, and hornblende, feldspar, quartz, garnet and diopside in the amphibolite (Herd and Dunning, 1979). In the King George IV Lake map area the complex has been retrogressed and is generally characterized by a greenschist assemblage of hornblende, biotite, epidote and calcite and by a granoblastic hornfels texture.

Contact relationships

Unit 1 is intruded by and occurs as xenoliths within the Lloyds River Intrusive Suite (Unit 11) and the biotite granite of Unit 16c. The relationship with Unit 11 can be readily observed along the north and south shore of the west arm of King George IV Lake. Anatectic banding or migmatite is locally developed in the contact zone.

KING GEORGE IV LAKE COMPLEX (UNITS 2, 3, 4)

Definition, Division and Distribution

The name King George IV Lake complex is formally proposed herein for the remnants of a dismembered and incomplete ophiolite that is exposed is the map area. The complex is separated from the surrounding rocks by faults.

The complex is exposed in a number of fault-bounded blocks bordering the east side of King George IV Lake. It is divided into three units, separated by faults, that represent three stratigraphic elements of an ophiolite. These are: (i) gabbro with minor diabase (Unit 2); (ii) sheeted dikes and gabbro screens (Unit 3); and (iii) mafic pillow lava, minor pillow breccia and pyroclastics cut by diabase dikes (Unit 4).

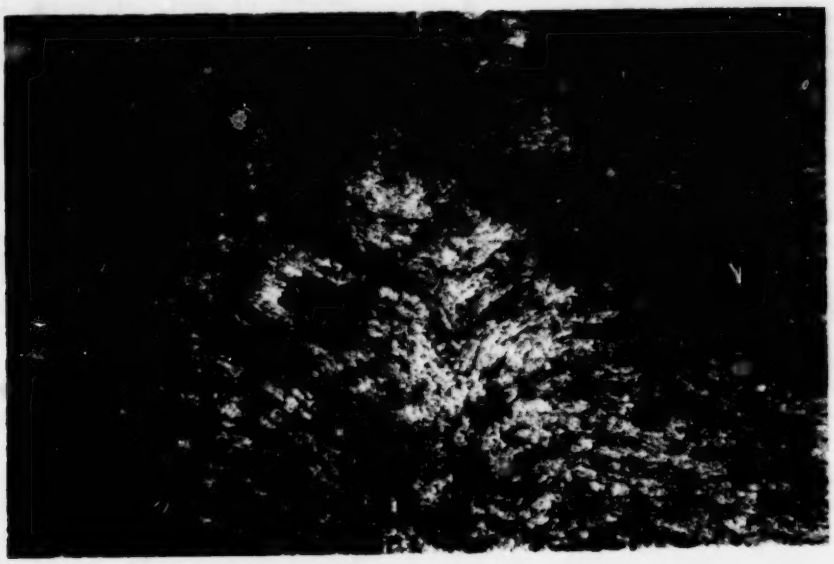


Plate 1: Deformed granite of the Cormacks Lake complex, Flat Bay Brook. Note the main fabric is transposed by a strain-slip cleavage.

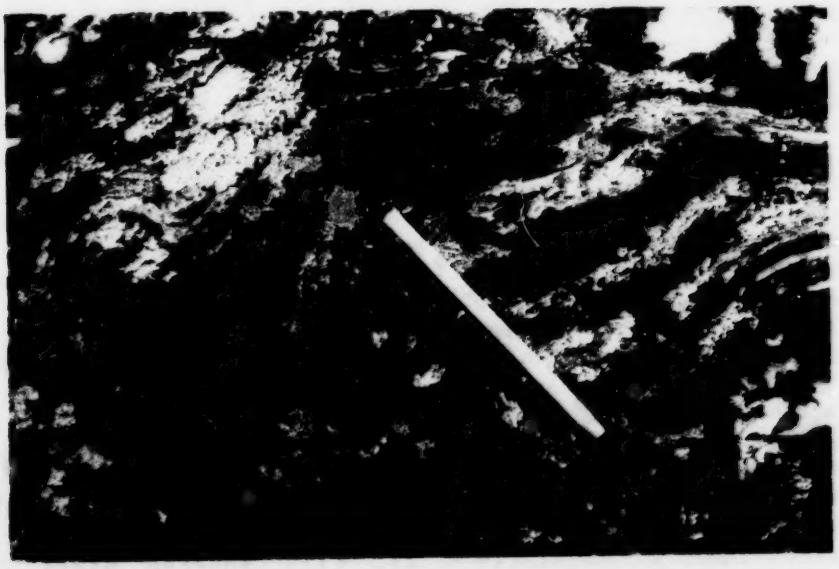


Plate 2: Refolded fold in paragneiss of the Cormacks Lake complex, north of King George IV Lake.

Age and Correlation

The complex is correlated with the Annieopsquotch Mountains complex (Dunning and Herd, 1980), a nearly complete ophiolite assemblage located approximated 8 km to the northeast. It is separated from the Annieopsquotch Mountains complex by faults and younger rocks. However, in contrast to the Annieopsquotch complex which faces northeast, the pillow lava in the King George IV Lake complex youngs to the west and southwest. It is interpreted to be part of an oceanic basement on which the Middle Ordovician and older Victoria Lake Group was deposited. Remnants of oceanic crust exposed in Notre Dame Bay are Cambro-Ordovician in age and it seems reasonable to suggest that the King George IV Lake complex is of a similar age and origin; however, it appears to have undergone a different tectonic and emplacement history. U/Pb age determinations on trondhjemite pods in gabbro from the Annieopsquotch Mountain complex yield an age of 477.5(+1.3; -1.0) Ma and an age of 481.4(+4.0; -1.9) Ma on trondhjemite in an intrusion breccia within a fault zone in the gabbro (Dunning and Krogh, 1983).

Unit 2

Distribution

Unit 2 constitutes approximately 25 per cent of the complex. It constitutes the southeastern part of the complex and extends from Mink Lake to Wood Lake. It is well exposed in the hills west of Wood Lake. Rafts and xenoliths of the unit occur in intrusive diorite and gabbro north of Boogie Lake.

Lithology

Unit 2 is composed of fine to medium grained, green and black gabbro. Similar gabbro also occurs as screens in the sheeted dike zone of Unit 3. The gabbro is generally equigranular but is locally feldspar-phyric and is intruded by fine grained diabase dikes. No primary igneous layering was noted in the main outcrop of Unit 2. In places the gabbro may actually be large, wide dikes within the sheeted dikes of Unit 3; poor exposure and general small outcrop size often prevent the recognition of chilled margins. Also, coarse grained dikes up to 10 m wide have been observed within the Annieopsquotch Mountains complex to the northeast. Coarse grained patches consisting of plagioclase and pyroxene are locally present but not common. North of Boogie Lake, medium to coarse grained, melanocratic gabbro with diabase and tonalite dikes occur and are referred to subunit 2a (Plate 3). A crude layering was noted in one outcrop of subunit 2a.

Petrography

Unit 2 gabbro consists mainly of plagioclase and clinopyroxene in about equal proportions, although locally the plagioclase predominates. The plagioclase has an intergranular to subophitic textural relationship to the pyroxene. The matrix plagioclase has a bulk composition of approximately An_{48} and is variably altered to a mixture of sericite, zoisite, epidote, calcite, albite and quartz. They are generally subhedral to anhedral crystals displaying albite and combined Carlsbad-albite twins; grain size varies from 0.5 to 1 mm. In the plagiophyric gabbro, phenocrystic plagioclase is up to 6 mm long and generally completely saussuritized. The pyroxene is predominantly clinopyroxene (diopsidic augite?); rare orthopyroxene was noted in one section. The clinopyroxene generally forms anhedral to subhedral crystals up to 0.5 mm. They exhibit simple twinning and are moderately to completely altered to a uralitic amphibole; chlorite, epidote, and carbonates are also common alteration products. The accessory minerals are magnetite, possibly other iron oxides, sphene and secondary alteration minerals such as chlorite, epidote, albite, quartz and carbonate. Saussuritized and uralitized fractures are common. The medium to

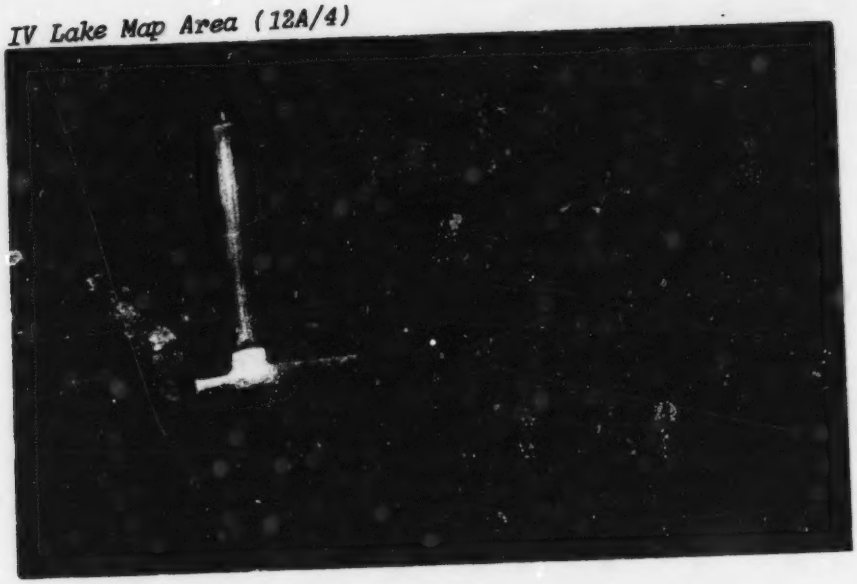


Plate 3: Coarse grained, melanocratic gabbro with thin diabase dike, King George IV Lake ophiolite complex, north of Boogie Lake.

coarse grained melanocratic gabbro of subunit 2a generally consists of moderately fresh, euhedral plagioclase (An_{55}) and intergranular ferromagnesian minerals. Plagioclase forms crystals of approximately 2 mm length in the medium grained rocks, and up to 6 mm but mostly about 4 mm in the coarse grained varieties. Colorless to slightly pinkish orthopyroxene that varies from nonpleochroic to slightly pink pleochroic and with low birefringence is probably bronzite or hypersthene and was noted in one thin section. However, brown to green pleochroic clinopyroxene crystals are the dominant pyroxene; in the medium to coarse varieties they have a grain size varying from <1 to 3 mm. The pyroxenes are moderately to extensively altered to green fibrous amphibole (actinolite-tremolite) and green granular hornblende. Dark brown hornblende and poikilitic magnetite are locally common; green chlorite is present as an alteration of hornblende. Rare crystals of altered olivine were noted.

Contact relationships

Unit 2 is in assumed fault contact with metamorphic rocks of Unit 8. The contact is not exposed. The contact with the Windsor Point Group (Unit 15) is not exposed and is assumed to be a fault, although an original unconformable relationship is inferred. It is in fault contact with Units 3 and 4 of the complex.

Unit 3

Distribution

Unit 3 comprises approximately 30 per cent of the complex and forms its northern part. It underlies the area south of Boogie Lake and east of King George IV Lake. It is best exposed in depressions cutting the unit.

Description

Unit 3 consists of diabase dikes and gabbro. This unit is interpreted to represent a transition zone consisting

of sheeted diabase dikes and gabbro. In outcrop the unit generally consists of fine to medium grained and locally coarse grained, equigranular and in places feldspar-phyric, green and rarely black, gabbro cut by diabase dikes. The diabase dikes are aphanitic to fine grained, and aphyric to locally plagiophyric. Red weathering picrite (?) dikes containing plagioclase and chrome diopside phenocrysts are subordinate to the diabase dikes. The dikes have chilled margins, trend northwest-southeast with local variations to north-south and have moderate to steep dips to the northeast. They vary in width from a few centimetres to several metres. Excellent sheeted zones consisting of dikes about 0.3 m wide are locally exposed. A transition zone of pillow lava with extensive dikes is exposed in the fault contact zone with Unit 4. The gabbro in many cases can be interpreted as screens between the diabase dikes; however, in some cases an aphanitic chilled margin is developed in the gabbro which grades, over widths which may exceed 10 m into medium to coarse grained cores suggesting that the gabbros are also dikes. Epidote pods and veins, and albite-epidote veins, in places up to 0.5 m thick, commonly crosscut the diabase and gabbro dikes and locally are concentrated along the dike margins. In the area southwest of Boogie Lake, medium to coarse grained hornblende tonalite (subunit 3a) occurs as dikes, veins and pods within gabbro and in places may constitute up to 40 per cent of the outcrop. Cataclastic textures and mylonites are locally developed, in particular along the fault contact with a sliver of the Victoria Lake Group southwest of Boogie Lake. There a 16 m wide cataclastic zone is developed.

Petrography

The diabase dikes and gabbro dikes and/or screens of Unit 3 are mineralogically and texturally alike; the main difference is in grain size. The aphanitic rocks consist of randomly oriented, subhedral plagioclase microlites, up to 0.2 mm long, displaying intergranular relations with a matrix of cryptocrystalline alteration products. Minor euhedral microphenocrysts and rare phenocrysts of plagioclase up to 1.7 mm in size are present. They are simply twinned and generally show normal zoning; the cores are generally completely saussuritized. The matrix consists of a cryptocrystalline aggregate consisting in part of iron oxide, chlorite, calcite, uralite and epidote. These cryptocrystalline aggregates are generally <0.2 mm across. The porphyritic dikes and fine to medium grained diabase and gabbro are subophitic to intergranular in texture, and locally ophitic. These rocks consist of randomly oriented, generally slender feldspar crystals, up to 1 mm long, in a matrix consisting of iron oxide, calcite, chlorite, epidote and uralitic and chloritized green amphibole after augite. The grain size of the mafic minerals and the alteration minerals is about 0.6 mm. The plagioclases are subhedral to euhedral and range from <1 to 5 mm in size. They are variably saussuritized and the larger crystals are more extensively altered. The matrix plagioclases have an average bulk composition of calcic andesine and generally display albite and Carlsbad twinning. Accessory minerals include iron oxide, sphene and secondary minerals such as chlorite, epidote, clinozoisite, calcite, albite and rare quartz.

The medium grained tonalitic and quartz dioritic dikes, veins and pods that intrude Unit 3 consist of relatively fresh to moderately saussuritized, subhedral to euhedral oligoclase-andesine (40 to 60 per cent), intergranular green-brown hornblende (20 to 30 per cent), quartz (15 to 25 per cent), and very rare orthoclase. The hornblende is variably altered to chlorite and commonly has poikilitic inclusions of plagioclase. Accessories include rare biotite, opaques, sphene and zircon.

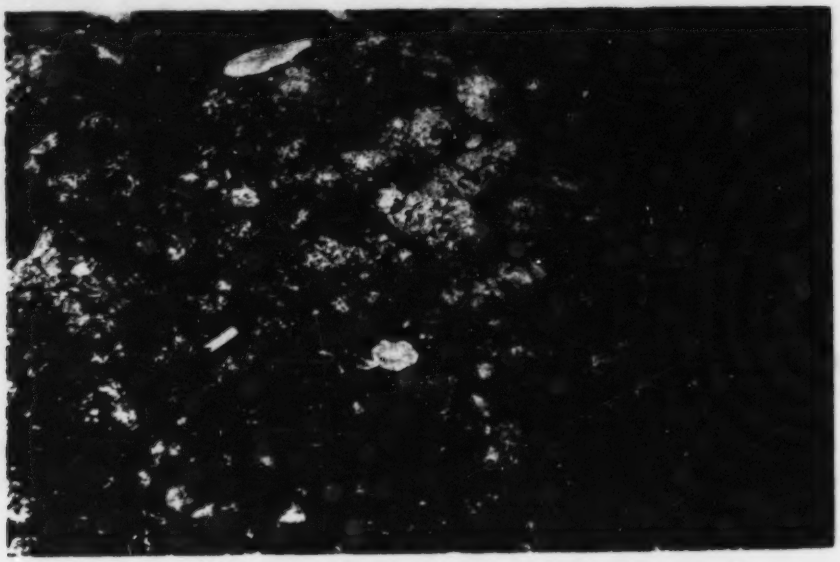


Plate 4: Pillow lava with minor interpillow material, King George IV Lake ophiolite complex, east of King George IV Lake.

Contact relationships

Unit 3 is in fault contact with the Victoria Lake Group. It is in assumed, fault-modified, unconformable contact with the Windsor Point Group. It is in fault-modified contact with the intrusive diorite and gabbro of Unit 14. It is in fault contact with Units 2 and 4 of the complex.

Unit 4

Distribution

Unit 4 comprises the remainder of the complex. It constitutes the western part of the complex along the east side of King George IV Lake. It is best exposed on the barren hilltop east of King George IV Lake.

Description

Unit 4 consists of basaltic pillow lava and rare pillow breccia. The pillows and pillow breccia are aphanitic to fine grained, dark green to black and generally nonvesicular. They are generally equigranular and aphyric but locally contain plagioclase phenocrysts, which are in places epidotized. Individual pillow structures range from well-rounded to bun-shaped and elongate and from 15 cm to 1.5 m in diameter (Plate 4). The smaller pillows generally have spherical shapes. Most of the pillows have thin selvages (up to 1.5 cm) and are generally closely packed and draped over each other. The pillows indicate younging to the west. Interpillow material is rare; where present it is red and rarely green chert and aquagene tuff. The breccia consists of angular pillow fragments, up to 10 cm across, in a fine grained tuffaceous matrix. Mafic aquagene tuff occurs in beds, up to 30 cm thick; red chert lenses up to 1.5 m thick are locally interbedded with these rocks. Diabase and gabbro dikes up to 1.5 m wide locally intrude the pillow lava.

Petrography

Pillow lava and breccia of Unit 4 are characterized by randomly oriented plagioclase microlites in a fine grained to cryptocrystalline matrix of alteration minerals. The plagioclase

microlites have an average length of 0.5 mm. In places subhedral to euhedral andesine microphenocrysts and phenocrysts up to 1 mm long are present. All of the feldspar is variably saussuritized. In places, the feldspar microlites display a radial or sheaf-like pattern producing a variolitic texture. The intersertal material generally consists of opaque minerals, iron oxides, chlorite, calcite, epidote, albite, quartz and possibly uralite. In places, simple-twinned augite is present as microphenocrysts. Veins are common, consisting of epidote, chlorite, uralite, etc. and, in places, solely of albite and quartz. In the cores of some pillows the plagioclase crystals have grain size up to 2 mm and the pyroxene is up to 1 mm. The gabbro and diabase dikes intruding the pillow lava are mineralogically and texturally similar to those in Unit 3.

Structure and Metamorphism of the King George IV Lake Complex

There is no regional penetrative fabric developed in rocks of the complex. However, in places, widely spaced northeast trending, steeply dipping and commonly hematized shear zones are developed. They are defined by streaky banding, slickensides, and by growth of chlorite and sericite. In these zones, pillow lava and red chert have developed pinch and swell structures. The shear zones have a marked topographic expression. As rocks of different lithologies are commonly juxtaposed along the shear zones, they are interpreted as faults. Cataclastic textures defined by crushed and rolled grains and banding are developed in some areas, particularly in Units 3 and 6.

The King George IV Lake complex has been metamorphosed under lower greenschist facies conditions and is characterized by the assemblage chlorite, uralite, epidote, calcite, albite and quartz.

VICTORIA LAKE GROUP (UNITS 5, 6, 7)

Definition, Division and Distribution

The name Victoria Lake Group was proposed by Kean (1977) to designate an assemblage of volcanic, epiclastic volcanic and sedimentary rocks on the north side of Victoria Lake in the Victoria Lake (12A/6) map area. This assemblage of rocks was previously assigned to the Strides Group (Riley, 1957). In the Victoria Lake map area, the Victoria Lake Group is bounded to the south by a probable Middle Ordovician black shale unit and to the northwest by ophiolitic gabbros and diorites of the Annieopsquotch Mountains. Subsequently, the Victoria Lake Group was expanded to include volcanic and associated sedimentary rocks in the Star Lake (12A/11) (Kean, 1979), Lake Ambrose (12A/10) and Noel Paul's Brook (12A/9) (Kean and Jayasinghe, 1980) map areas. In each of these areas, the group is bounded to the north by the conformably overlying sedimentary rocks of the Harbour Round Formation and to the south by the locally unconformable overlying Rogerson Lake Conglomerate (Kean and Jayasinghe, 1980). The base of the group has not been defined but the Annieopsquotch Mountains ophiolite complex is interpreted to represent the oceanic crust upon which the group was deposited.

In the north-central part of the present map area, the Victoria Lake Group occurs as an approximately 2 km wide, northeast trending band of volcanic, epiclastic-volcanic and minor sedimentary rocks. It forms the southwesterly extension of the Victoria Lake Group from the Victoria Lake map area (Kean, 1977). The group is interpreted to be in fault-modified, unconformable contact with the overlying conglomerate of Unit 9 to the south. A fault contact with the King George IV Lake complex and an intrusive contact with Unit 14 define its northern limit.

King George IV Lake Map Area (12A/4)

The Victoria Lake Group within the present map area is herein divided into three unnamed units (5, 6 and 7) of formational rank. The lack of geopetal features, structural data, and critical exposures precludes the determination of the relative ages, thicknesses, or internal stratigraphy of these units. The designation of meaningful type sections is not possible; reference sections with well exposed representative rock types are given instead.

Mafic pillow lava of Unit 5 is considered to be the oldest unit within the Victoria Lake Group. Interbedded mafic and felsic volcanic rocks (Unit 6) and felsic and epiclastic volcanic rocks (Unit 7) adjoin it to the north and south respectively.

Age and Correlation

Limestone lenses from near the top of the Victoria Lake Group near the mouth of Red Indian Lake (12A/10) and south of Buchans Junction (12A/16) contain conodonts of late Llanvirn - early Llandeilo age (Kean and Jayasinghe, 1980, 1982). The Victoria Lake Group thus belongs to the early arc phase of volcanism as described for Notre Dame Bay (Dean, 1978). These dated rocks are laterally continuous with the Victoria Lake Group in the King George IV Lake map area. Previously, workers have implied a correlation between the Victoria Lake Group and the Exploits Group of central and eastern Notre Dame Bay (Williams, 1970; Erdtmann, 1976).

The Victoria Lake Group is also considered a correlative of Unit 8, a sequence of sedimentary and metasedimentary rocks and their migmatitic equivalents.

Mafic Pillow Lava (Unit 5)

Definition and distribution

Unit 5 consists principally of pillow lavas and minor pyroclastic rocks, and represents one of the largest units of pillow lava recognized within the entire outcrop area of the Victoria Lake Group in central Newfoundland. It forms the central outcrop area of the Victoria Lake Group and extends from Boogie Lake in the south to the north boundary of the map. The continuation of the unit to the southwest is in part disrupted by faults and intrusions. It is interfingered with Unit 7 to the northeast. Representative exposures of the unit occur in an area approximately 1 km due east of the Burgeo Road, approximately 3.5 km south of the northern boundary of the map sheet. Isolated outcrops of the unit occur along the Burgeo Road.

Lithology

Unit 5 is composed predominantly of fine grained, dark green to apple green mafic pillow lava. Minor mafic agglomerate, tuff and rare interbedded red argillite, felsic tuff and chert are also locally present. Individual pillow structures are generally well rounded, less than 0.5 m in diameter, and rimmed by chloritized selvages varying from 0.5 to 1 cm in thickness. The pillows are generally not highly vesicular. Interpillow material is minor, but locally brown weathering, green on fresh surface, aquagene tuff and red chert are present. Near fault zones, the pillow lava is extensively hematized. Vesicular mafic agglomerate with bombs up to 20 cm set in a fine grained, green (locally hematized) matrix of mafic tuff comprises only a small part of Unit 5; it is characteristically highly cleaved. Cleaved and schistose mafic tuff locally occurs as thin intercalations in the pillow lavas. Epidote and calcite as veins, pods and disseminations are ubiquitous.

Plagiophyric mafic flows and/or crystal tuffs with thin beds of fine grained, cleaved and schistose felsic tuff form a small proportion of this unit. Highly cleaved argillite and minor, highly altered and sheared light green felsic tuff outcropping west of

the Burgeo Road are also included in the unit although the relationship with the pillow lavas is unknown.

Vesicular and locally feldspar-phyric pillow lava, agglomerate, isolated pillow breccia and mafic tuff occur south of Boogie Lake in fault-bounded, narrow slivers within the King George IV complex. They are tentatively included in Unit 5 because of the presence of sedimentary rocks within them (Hudson's Bay Oil and Gas personnel, personal communication, 1981) but they could also be part of the ophiolitic sequence.

Petrography

The pillow lavas vary from moderately to completely altered, and a lower greenschist facies mineralogy is ubiquitous. The crystalline cores of the pillows consist of stumpy, euhedral plagioclase crystals 0.2 to 0.4 mm long, and fine grained to cryptocrystalline intersertal alteration minerals. Epidote, calcite, opaques, iron oxides, minor chlorite, albite and quartz are the most common secondary minerals in the interstices. The plagioclase crystals are partly or completely saussuritized, are unzoned, and display albite and combined Carlsbad-albite twins. Some of the less altered plagioclase has a bulk composition of An_{40}; however, many are albitized. The occurrence of large epidote grains or aggregates suggests the presence of original mafic or feldspar phenocrysts.

Aphanitic pillows and pillow selvages consist of slender laths of plagioclase in a brownish, semi-transparent, fine grained to cryptocrystalline matrix. The original matrix was probably glassy. The plagioclase microlites average 0.2 mm in length, and are generally randomly oriented and locally radially disposed. The matrix consists essentially of opaques (leucoxene is common), epidote, calcite, chlorite, albite and quartz. In places, feldspar microlites have the feathery texture indicative of quenching. The microlites generally appear unaltered or less altered than the larger crystals, but this may be a result of complete albitization of the original feldspar. Rare unzoned euhedral plagioclase microphenocrysts with a grain size of up to 1 mm are also generally altered and albitized; the least altered give compositions of An_{32}. Iron oxides and sphene are the main accessory minerals. Calcite and epidote occur extensively as veins and in fractures and vugs. Minor veinlets of quartz and albite are also present.

The mafic tuff is composed of chloritized and epidotized cryptocrystalline material. The tuff may originally have been formed as aquagene tuff. Chloritized angular clasts are visible locally, but generally, textures are not preserved.

The felsic tuff consists of a fine grained to cryptocrystalline interwoven mesh of quartzofeldspathic material. Angular quartz fragments are recognizable in places and sericite is commonly disseminated throughout the rock. Quartz veinlets are common.

Contact relationships

Unit 5 is considered the oldest unit in the Victoria Lake Group and may represent either the upper pillow lava sequence of an ophiolite or the stratigraphically overlying basal part of an island arc. Lithologically, it resembles the basaltic pillow lava (Unit 4) of the Annieopsquotch Mountains complex, but is generally more deformed and altered. The contact with Unit 6 is not exposed but extensive shearing suggests it may be fault-modified. The contact with Unit 7 appears to be gradational. In places it contains thin horizons of sedimentary rocks and appears to be interfingered with rocks of Unit 7 in the northeast. It is intruded by diorite and gabbro of Unit 14.

King George IV Lake Map Area (12A/4)

Interbedded Mafic and Felsic Tuff (Unit 6)

Definition and distribution

Unit 6 is an interbedded sequence of mafic and felsic tuff and minor flows and sedimentary rocks. It occurs in a discontinuous belt from Boogie Lake in the south to the northern boundary of the map area. The Unit forms the northern margin of the Victoria Lake Group. The unit is best exposed along the Burgeo Highway.

Lithology

Unit 6 consists almost entirely of bedded mafic and felsic tuff interlayered on a scale of a few centimetres; thicknesses in the order of tens of metres are locally present. Stratification within the layers is commonly obscured by deformation but where recognizable thicknesses are in the order of 0.5 to 6 cm. The proportion of mafic to felsic tuff in the unit varies but, overall, the mafic rocks predominate.

The mafic rocks are generally extremely fine grained, dense, dark green to black, tuff and feldspar-erupted tuff. They are thermally metamorphosed in proximity to Unit 14. In places they have a fine grained amphibole growth along the foliation planes and locally they are amphibolites. In places, feldspar crystals and crystal fragments are common in the mafic tuff matrix. Chlorite schist and graphite schist are locally developed in these rocks.

The felsic rocks are light colored, fine grained tuffs and small quartz-eye-crystal tuffs. Sericite is extensive in these rocks and generally defines a foliation; locally the rock is a sericite schist. Medium grained quartz-feldspar-crystal tuff and quartz-rich epiclastic graywacke is a minor constituent of this unit. Rare interbedded red argillite was noted in a few outcrops.

Shearing and slickensides are common in this unit and crushed and rolled grains are locally present. Pyrite is extensive, occurring as disseminations throughout the rocks and also as growths along slickenside planes. Disseminated galena and sphalerite in felsites were noted in one outcrop near the northern border of the unit along the Burgeo Road. Undeformed diabase, gabbro and medium grained pink granite dikes intrude the unit.

Petrography

The mafic rocks have a fine banding produced by alternating mafic and quartzofeldspathic bands. The unit shows an increase in metamorphic grade from lower greenschist to amphibolite facies towards Unit 14 in the north. The mafic bands predominate and are up to 1 cm wide; in contrast, the felsic bands are generally only 1 mm wide. In the lower grade rocks, the mafic bands consist of very fine (0.01 mm) to fine (0.04 mm) grained, yellow, brown and green clay and alteration minerals (chlorite, epidote, etc.) and feldspar and quartz grains. A local development of fluxion lines and crushed tails occur on small feldspars. In places, subhedral to euhedral andesine feldspar (An_{32-38}) grains up to 1 mm long form a glomeroporphyritic texture. These feldspars are not extensively saussuritized and are generally randomly oriented, although some are rotated to the plane of the foliation. The felsic bands consist of fine grained interwoven feldspar and quartz with minor quartz crystals and crystal fragments. Plagioclase is also present as minor crystals. The crystals are broken and in many cases recrystallized.

Mafic bands in the hornfelsed mafic rocks consist of green-brown pleochroic hornblende crystals, and intergranular, granoblastic or polygonal plagioclase and quartz that mimics an earlier foliation. Hornblende forms equidimensional and granoblastic crystals up to 0.1 mm across that in places are altered to epidote, chlorite and calcite. The

quartz and feldspar form crystals 0.04 mm across. The felsic bands consist of feldspar, quartz and minor hornblende with grain size up to 0.04 mm and an (incipient) polygonal texture. Euhedral garnets overgrow the banding and foliation; in places, the garnets are elongate indicating preferential growth along the foliation. The garnets are also slightly augened in places. A late, widely spaced fracture cleavage transects the banding and gives rise to drag structures.

The felsic rocks consist of alternating 5-10 mm wide quartzofeldspathic bands and thin (<1 mm) biotite-rich bands. The quartzofeldspathic layers consist of equidimensional, interlocking quartz and feldspar crystals with a grain size up to 0.2 mm. Grain boundaries vary from sutured to polygonal, and the quartz generally has undulose extinction. Flakes of biotite, (0.1 to locally 0.6 mm) define a weak foliation parallel to the banding, and form intergranular textures with the quartz and feldspar. The mafic bands consist of elongate and oriented biotite flakes, (0.3 mm long, and minor feldspar and quartz. Euhedral garnets, up to 0.9 mm across, overgrow the banding and foliation; in places biotite forms augen around the garnets.

Veins of calcite, epidote and quartz are common. Iron oxides and other opaques are the most common accessory minerals.

Contact relationships

Unit 6 is intruded by Unit 14 which forms its northern contact. It is in assumed fault contact with Unit 5.

Intermediate and Felsic Volcaniclastic Rocks (Unit 7)

Definition, division and distribution

Unit 7 is a northeast trending sequence of mafic, felsic and intermediate volcanic, epiclastic and sedimentary rocks exposed in a narrow belt forming the southern boundary of the Victoria Lake Group. It extends from Wood Lake in the south to the northern boundary of the map area. The Unit is best exposed in low lying outcrops in bogs to the east of the Burgeo Road. The unit is divided into two subunits on the basis of rock type.

Subunit 7a consists of intercalated mafic volcanics, minor felsic tuff, red and green argillite and siltstone and minor chert. Subunit 7a constitutes the northeast portion of Unit 7 and is traceable to the northeast into the Puddle Pond map area.

Subunit 7b is composed of intermediate to felsic quartz-feldspar crystal tuff, lapilli tuff and breccia, associated volcaniclastic rocks and sericite schist. It continues into the Puddle Pond map area to the northeast; the southwest extension is disrupted and terminated by faulting. Black and gray bedded chert occurring in the extreme northeast part of subunit 7a are similar to chert associated with the Annieopsquotch Mountains complex to the north (G. Dunning, personal communication, 1980). Nevertheless, similar chert was also noted elsewhere within the Victoria Lake Group (Kean, 1977; Kean and Jayasinghe, 1980, 1982).

Lithology

Subunit 7a consists of a variety of rock types. Structureless to locally cleaved, fine grained, green intermediate to mafic volcanic rocks are in places pillowed; elsewhere they appear to be either massive flows or sills or even thickly bedded tuff. Near the contact with Unit 5 and also in the transitional zone with subunit 7b, subunit 7a consists of intermediate tuff interbedded with 2-3 cm thick layers of red and green argillite, siltstone and quartz-feldspar crystal tuff. Quartz crystal tuff and intercalated sericite schist, mafic volcanics and intermediate feldspar

crystal tuff are interbedded with thin layers of bedded green, black and minor red siltstone and argillite in the northeastern part of the subunit. Minor gray and black chert occur in this area. Subunit 7a is in part lithologically similar to Unit 6.

Subunit 7b consists of intermediate to felsic, whitish weathering, green, locally buff volcanic graywacke and breccia, quartz-feldspar-crystal ± lithic tuff and lapilli tuff, and sericite schists derived from them. The volcanic graywacke and breccia are generally more extensively developed near the contact with subunit 7a. Interbedded fine grained, green siltstone and green, gray and black shale are locally common. This unit is generally cleaved to schistose, particularly in the southern outcrops of the unit. The main detrital components in the volcaniclastic graywacke are green felsic volcanics and siliceous siltstones. They occur as clasts ranging in diameter from <1 mm to >15 cm; these clasts are characterized by either rounded or wispy ends. Locally, the maximum dimension of the clasts exceeds 30 cm. Quartz and feldspar crystals and crystal fragments up to 3 mm across are common. Black slate, shale, argillite, mafic volcanic and rare red chert constitute the remainder of the detrital assemblage. The matrix of these rocks consists of fine grained lithic, feldspar and quartz fragments. The graywackes grade into and are intercalated with feldspar crystal tuffs.

Undeformed or fracture cleaved, gray-green, quartz ± feldspar crystal and crystal-lithic tuffs, vitric tuffs and buff colored to white sericite schists constitute the remainder of the subunit. Bedding is not well developed or evident in these rocks; however, the intercalation of sericite schist, quartz "eye" sericite schist and undeformed quartz-feldspar vitric tuff in the same outcrop suggest an original lithological layering. In places these rock types contain thin interbeds of mafic volcanics. A variation from crystal and lithic tuff to crystal and lithic lapilli tuff, and in places to breccia, is observable in some outcrops.

Quartz veining is extensive and in places contains pyrite and rare chalcopyrite.

Petrography

The intermediate tuffs and sericite schists of subunit 7a consist essentially of seriate feldspar crystals and crystal fragments with a grain size that varies from 0.5 to 3.5 mm. The feldspars vary from euhedral to broken and angular; some have undergone *in situ* brecciation. In places they are clustered giving rise to a glomeroporphyritic texture. The feldspars are moderately to extensively saussuritized. They generally possess albite and combined Carlsbad-albite twins and are of oligoclase composition. Angular to subrounded quartz fragments, generally less than 1 mm, occur as isolated clasts and as fine disseminations throughout the matrix. Rare subhedral orthoclase crystals and minor lithic clasts, generally less than 0.7 mm in size, were noted. Grains and granular patches of epidote occur scattered throughout the rock. The matrix consists of quartz and feldspar grains in a quartzofeldspathic to feldspathic intergrowth with a grain size generally less than 0.04 mm. The matrix is extensively altered to calcite and sericite; chlorite is locally developed. A foliation defined by sericite and chlorite is inhomogeneously developed and forms augen around clasts. Pyrite is common as an accessory mineral.

The sedimentary rocks of Unit 7 consist of abundant sericite and well sorted, fine grained to submicroscopic material. Hematite is extensive in places and imparts a red color to some of the rocks. Small scale disruptions of bedding and soft-sediment slumping and injections are common. Quartzo-

feldspathic veins are common and pyrite is disseminated throughout. The cherts are typified by fine grained intergrowths with 'salt-and-pepper' textures. Calcite occurs locally throughout the matrix and quartz veins and veinlets are common. White mica (sericite?) forms discontinuous veinlets and also occurs as rare random flakes.

The volcanic breccia and graywacke of subunit 7b consist of lithic rock clasts and feldspar and quartz fragments in a fine grained to submicroscopic matrix. The quartz is always subordinate to feldspar. The proportion of crystals to lithic clasts is variable; either crystal or lithic fragments may be predominant. The most common lithic clasts are fine grained, banded or bedded felsite and/or siliceous siltstone. These clasts are generally elongate with either rounded or wispy ends and range in size from <1 mm to a maximum of 30 cm (Plate 5). The light and dark banding or bedding in these clasts occurs on a scale of 3 to 6 mm and reflects a difference in grain size and composition. The light colored bands consist of fine grained, angular feldspar and minor quartz fragments in an aphanitic or cryptocrystalline carbonate-rich matrix. The dark bands consist of submicroscopic material with flecks of sericite and lesser carbonate. Spidery or 'salt-and-pepper' textures are common in the dark bands. Pyrite is a common accessory mineral in these clasts. Other clasts include angular basalt (in places with distinct plagioclase microlites and saussuritized microphenocrysts of plagioclase), felsite, silicic volcanic and rare quartz-feldspar crystal tuff. Feldspar occurs as broken and angular grains and euhedral crystals varying from <0.2 to >1 mm in size; they are generally variably saussuritized. In places they are completely altered to clinozoisite and/or fine grained carbonate. Quartz occurs as angular and subrounded grains varying from <1 to 2 mm in size.

The matrix of the volcanic breccias and graywacke contains minor feldspar and quartz clasts in fine grained to cryptocrystalline detritus. Sericite locally defines a foliation which forms augen around clasts. Calcite is generally extensive and chlorite in vesicles or knots is locally present. Quartz and calcite veins are also common. Accessory pyrite is disseminated through the rock.

The pyroclastic rocks are predominantly quartz-feldspar crystal tuff, minor lapilli tuff, and their schistose equivalents. Quartz is generally the main crystal type; locally, however, euhedral seriate crystals of feldspar predominate. In the crystal tuff and sericite schists, quartz occurs as broken, angular to rounded grains, and hexagonal bipyramidal quartz crystals up to 4 mm in size (Plate 6). The hexagonal quartz crystals are in places brecciated *in situ* and contain lobate and vermicular embayments filled with calcite. Seriate crystals and crystal fragments of oligoclase-andesine, up to 3 mm in size, generally display albite and combined Carlsbad-albite twins and are moderately to completely altered to calcite, epidote, clinozoisite, and quartz ± albite. Orthoclase and large granular epidote fragments are also present. Fine grained siliceous siltstone, felsite and rare basalt clasts vary in size from <1 to >10 mm. The clasts are commonly aligned, and in the sericite schist the foliated sericitic matrix forms augen around them. In places this has resulted in a crude microscopic banding. The matrix of the tuff varies from devitrified (cryptocrystalline) tuff with minor to extensive fine grained sericite flakes, to a fine grained to cryptocrystalline mixture of microscopic feldspar, quartz and various alteration minerals. Calcite is extensive, in the groundmass, in vugs and in veins. Pyrite and minor opaques are disseminated throughout the rock.

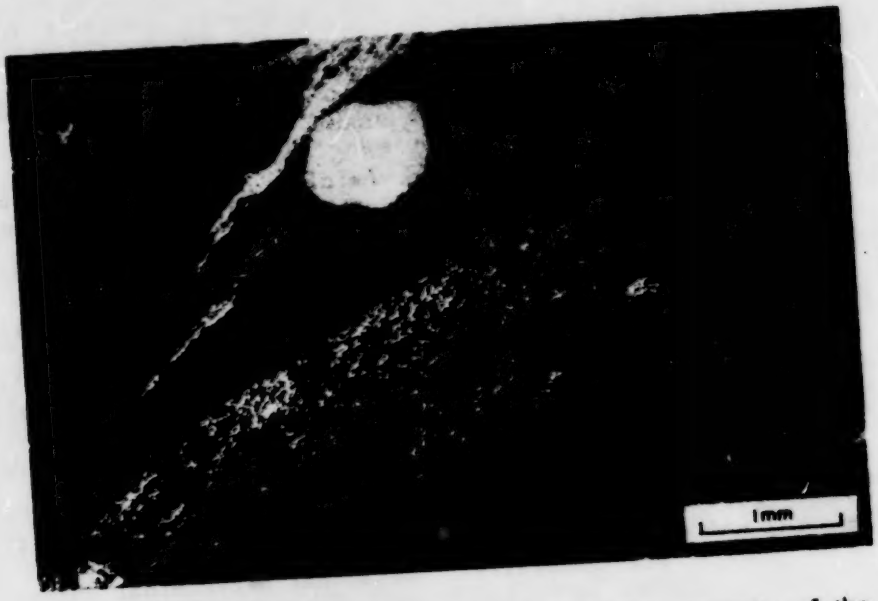


Plate 5: Lithic and quartz clasts in volcaniclastic graywacke of the Victoria Lake Group, east of the Burgeo Road.

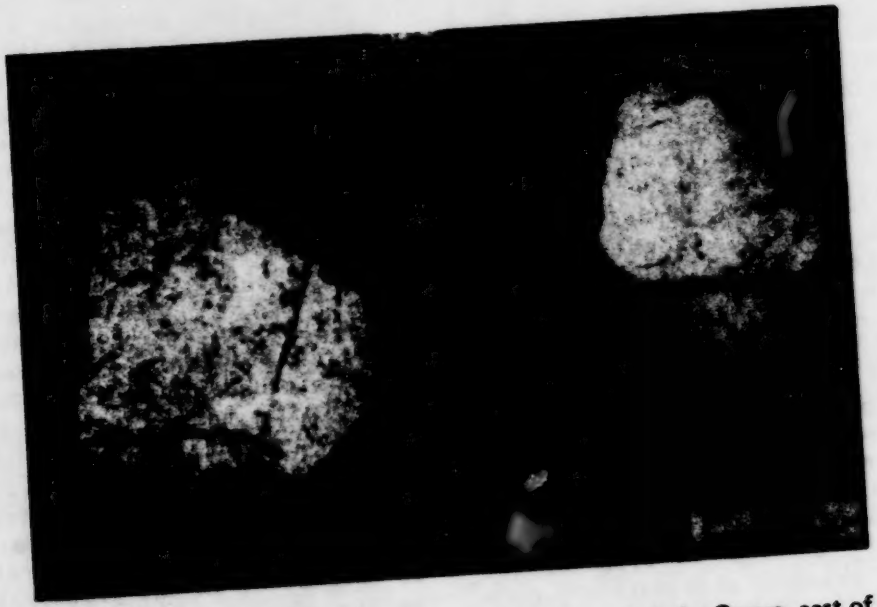


Plate 6: Quartz-feldspar crystal tuff of the Victoria Lake Group, east of Burgeo Road.

Contact relationships

Unit 7 is overlain to the south by conglomerate (Unit 9). Although the contact is not exposed in the map area, it is unconformable to the northeast (Kean and Jayasinghe, 1980). Extensive shearing and cataclasis in the contact region suggests that the original contact relationships are now modified by faulting. The contact with Unit 5 is not exposed and is probably in part modified by faulting, although an interfingering with Unit 5 and subunit 7a is implied from the outcrop distribution. Subunit 7a is interpreted to grade into subunit 7b by an increase in the proportion of felsic rocks.

Structure and Metamorphism of the Victoria Lake Group

The rocks of the Victoria Lake Group have all undergone a regional penetrative deformation which was accompanied by a regional greenschist facies metamorphism. The deformation is inhomogeneously developed and the associated foliation varies between fracture or slaty cleavage, phyllitic foliation, and chlorite and mica schistosity. Sericite and minor chlorite define the foliation in the lower greenschist grade intermediate and felsic rocks, and form augen around resistant knots. Chlorite defines the fabric in the mafic rocks. In the upper greenschist grade rocks, the foliation is defined by biotite, muscovite and green hornblende. The Victoria Lake Group is generally more highly schistose in its southern parts, particularly near a presumed fault contact with Unit 9 and about 1.5 km north of a major regional fault affecting Unit 10. There, augen structures and crush trails on feldspar and quartz are locally developed. Similar features are also locally developed within the greenschist facies mafic tuff of Unit 6. The cleavage and schistosity are generally parallel to bedding planes; and cleavage-bedding intersections were recognized in a few outcrops. Tight to isoclinal, moderately steep south plunging minor folds folding an early foliation were seen in Unit 6 tuff along the Burgeo Road. The lack of younging and vergence directions precludes the delineation of large scale folds.

The rocks of the Victoria Lake Group were metamorphosed to the greenschist facies; a metamorphic assemblage of calcite, epidote, chlorite, sericite, albite and quartz is ubiquitous. Amphibolite grade hornfels consisting of granoblastic green hornblende and plagioclase (+ quartz) in the mafic rocks, and quartz-plagioclase-biotite in the felsic rocks, occurs near the contact with intrusive rocks of Unit 14. The granoblastic texture partly obliterates but largely mimics the pre-existing tectonic fabric.

BAY DU NORD GROUP(?) (UNIT 8)

Definition, Division and Distribution

Unit 8 is tentatively assigned to the Bay du Nord Group. Cooper (1954) defined the Bay du Nord Group as a sequence of metasedimentary rocks exposed in two belts, an eastern belt extending northeastward from La Poile Bay through North Bay and Round Hill Brook, and a western belt extending northeastward from Garia Bay to meet the first near the headwaters of the La Poile River. A Devonian age was assigned to this Group on the basis of plant fossils in the western belt (Dorf and Cooper, 1943). However Chorlton (1980b) redefined the Bay du Nord Group to exclude the fossil-bearing sequence.

Unit 8 is a sequence of sedimentary and metasedimentary rocks and migmatites that forms a northeast trending belt, up to 12 km wide, which underlies much of the central part of the map area. A small band of similar sedimentary rocks that underlies the extreme southeast corner of the map area forms part of a much larger belt that extends to the south (Chorlton, 1980a, b) and is herein included in Unit 8. The main outcrop of

King George IV Lake Map Area (12A/4)

Unit 8 is bound to the north by a fault, probably a splay of the Cape Ray Fault (Chorlton, 1978, 1980b). It separates Unit 8 from the King George IV Lake complex, the Devonian Windsor Point Group, and from the Victoria Lake Group. A linear body of mylonitized granite (Unit 10) is intruded along, or in close proximity to, the northwestern boundary of Unit 8. Unit 8 is intruded in the south by granitoid rocks of Units 12, 13, and 16; this southern boundary is approximately defined by the Burnt Pond River - Spruce Pond drainage system.

Although the continuation of Unit 8 to the northeast is partly truncated by granites of Unit 13, its extension into central Newfoundland has been demonstrated (Kean, 1977; Kean and Jayasinghe, 1980; Dickson and MacLellan, 1981). It also extends into the Peter Snout map area (11P/13) to the southwest (Chorlton, 1980a). A representative section of part of the unit is exposed along the Burgeo Road.

The unit has been divided into five subunits (8a, 8b, 8c, 8d and 8e) on the basis of rock type and/or metamorphic grade. Sedimentary rocks (8a) are interpreted as protoliths to the metamorphic rocks, which include schist (8b), paragneiss (8c), amphibolite (8d) and migmatite (8e). This is interpreted to be a result of progressive metamorphism from north to south.

Age and Correlation

The sedimentary/migmatite terrain of Unit 8 within the King George IV Lake map area is undated. However, it is correlative and continuous with parts of the Bay du Nord Group to the south and southwest (Chorlton, 1978, 1980a,b). There the Dolman Formation of the Bay du Nord Group was dated at 449 ± 20 Ma (Dallmeyer, 1979; Chorlton, 1980a). Similar rocks occur to the northeast in the Victoria Lake area (Kean, 1977), the Granite Lake area (Dickson and MacLellan, 1981) and the Lake Ambrose - Noel Paul's Brook area (Kean and Jayasinghe, 1980). They are undated but are generally considered to be Middle Ordovician and older on the basis of correlation with dated rocks; however, Kean (1977) and Williams (1970) indicated the presence of possible Silurian age rocks. The age of metamorphism is considered to be mainly Silurian.

Sedimentary Rocks and Schists (Subunits 8a and 8b)

Definition and distribution

Subunits 8a and 8b constitute a northeast trending and steeply dipping sequence of fine grained clastic sedimentary rocks and subunits derived from them. They occupy a narrow belt adjoining Victoria River north of Peter Strides Pond and subunit 8a also underlies a small area in the extreme southeast corner of the map area. The rocks are generally very poorly exposed; best exposures occur along the south shore of Victoria Lake and in the vicinity of Gable Pond.

Lithology

Northeast striking and steeply dipping, thinly bedded (5 mm - 4 cm, and rarely up to 15 cm) gray, green and black argillite, siltstone, mudstone, slate and phyllite with interbedded light gray tuffaceous sandstone beds and lenses constitute subunit 8a (Plate 7). Small, white, lithic and feldspar clasts are locally present in the sandstone. The sequence is evenly and rhythmically bedded. Bedding thicknesses vary from 0.5 to 5 cm. Bedding contacts are generally sharp with little evidence of erosion or scouring. Graded bedding is locally present and indicates younging of the unit to the south. Thin bands of mafic tuff locally occur throughout the sequence. Cataclastic textures such as rolled grains and an anastomosing fabric are developed on the south side of Victoria Lake. Veins and tongues of granite are locally present.

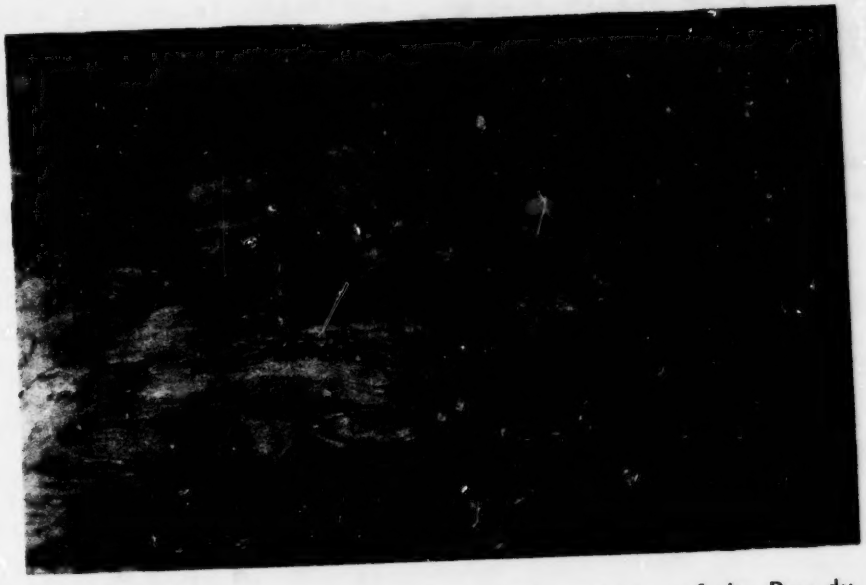


Plate 7: Interbedded siltstone, argillite and sandstone of the Bay du Nord (?) Group, Victoria Lake. Note granite dike under the hammer.

South of Victoria Lake and Victoria River, the metamorphic grade and intensity of deformation increase and subunit 8a grades into the schists of subunit 8b. Micaceous semipelitic schist and chlorite schist are the most common rock types; however, garnet-biotite-muscovite-staurolite schists are developed near the contact with the deformed granites of Unit 10. Quartz and granite veins are common in places.

Petrography

The clastic rocks of Subunit 8a consist of well sorted, graded and interlaminated light colored quartzose layers and dark colored siltstone or mudstone layers. The quartzose layers consist essentially of equigranular fine grained quartz with a grain size of 0.05 to 1 mm and irregular to sutured grain boundaries. Feldspar generally is a minor constituent and occurs most commonly as crystal fragments in the coarser beds. Flecks of white mica, clay minerals, chlorite and rare biotite (<0.05 mm) are in most places preferentially oriented parallel to bedding. The quartz-rich bands grade into the dark layers by a decrease in grain size and an increase in the mica and clay mineral content; the latter may constitute up to 80 per cent of the dark bands. The grain size of these layers is generally <0.03 mm. Diagenetic pyrite is common. Quartz veinlets, in places subparallel to bedding, show pinch and swell structures, and locally form augen. Extinction is undulose, subgrain boundaries are developed and incipient recrystallization is common in these veins. Kink bands at a large angle to bedding are locally developed.

The schists of subunit 8b consist of 1-2 mm thick quartz- and mica-rich bands. The quartz grains generally display undulose extinction and are elongated, defining a foliation. Large, lenticular quartz grains are locally present. Sutured grain boundaries and subgrain boundaries are developed and incipient polygonization is locally developed. Muscovite and biotite in the quartz-rich layers occur as oriented intergranular flakes. In the micaceous layers, muscovite and biotite predominate and define a foliation. The biotite forms grains from <1 to 4 mm long; the

muscovite generally is 0.1 to 0.2 mm long. Feldspar and elongate quartz are minor constituents and locally form very thin bands within the micaceous layers. The higher grade rocks contain garnet and staurolite. Staurolite develops along the bands in the direction of the fabric and attains a length of >5 mm. It overgrows and includes, as straight inclusion trails, the fabric-forming minerals; however, the fabric also forms augen around the staurolite (Plate 8). Euhedral garnets, up to 2.5 mm across, contain inclusion trails of fine quartz at an angle to the enclosing fabric. The garnet and enclosing fabric form augen structures (Plate 9). Sphene and calcite are present as accessory minerals.

Structure and metamorphism

Rocks of subunits 8a and 8b possess a northeast trending, steeply dipping planar anisotropy that varies from a slaty fracture cleavage in the north to a phyllitic fabric or schistosity in the south. In the phyllites the cleavage is defined by fine grained sericite and possibly clay minerals. The schistosity is defined by quartz, muscovite and biotite. Northeast plunging folds of the interbedded sediments can be seen in the Victoria Lake area. Kinks with a nearly horizontal axial plane and shallow southeast plunge are developed in subunit 8a along the west shore of Gable Pond. Steeply east to northeast plunging small scale, minor folds are developed in the semipelitic schist and the cross-cutting granite veins south of Victoria River.

Rocks in the northern part of subunit 8a are metamorphosed under greenschist facies conditions; however toward the south the metamorphic grade increases to amphibolite facies in subunit 8b. This southward increase in metamorphic grade towards a granitic terrain corresponds to a regional pattern identified elsewhere in central Newfoundland (Williams, 1970; Kean, 1977; Kean and Jayasinghe, 1980). The increase in metamorphic grade to amphibolite facies over a short distance is spatially correlative in this area with contact metamorphic effects of nearby granite (e.g. Unit 10). The granite is interpreted to have been emplaced into a deformed and probably greenschist grade metamorphosed terrain and to have superimposed an amphibolite (garnet and staurolite) grade hornfels metamorphism on the regional metamorphism. Subsequent deformation (recorded mainly as a mylonitic fabric in the granite) has superimposed its effects.

Contact relationships

Subunit 8a in the Victoria River area is bordered to the north by conglomerate (Unit 9). Although their contact is not exposed in the present area and is interpreted as a fault, an unconformable relationship has been interpreted on the basis of exposures in areas to the northeast (Kean and Jayasinghe, 1980). The outcrops in the extreme southeast are intruded by the porphyritic granites of Unit 13; however the contact is modified by faulting. Subunit 8a is cataclastically deformed along Victoria River and displays a metamorphic gradation into subunit 8b. Subunit 8b is intruded by granitoids of Unit 10.

Paragneiss and Amphibolite (Subunits 8c and 8d)

Definition and distribution

Semipelitic to psammitic metasediments and paragneiss (subunit 8c) and amphibolite (subunit 8d) form a northeast trending belt underlying the southwest part of the map area. It constitutes the northern portion of Unit 8 for most of its strike length. Subunit 8d extends into the Peter Strides Pond area. A linear, northeast trending deformed granite (Unit 10) intrudes and contains xenoliths of subunit 8c and divides it into two separate belts. The amphibolite occurs as small bands within 8c and in places as larger mappable members. Xenoliths of the semipelite,

Plate 8: Staurolite, with quartz-mica inclusion trails, forming augen in schists of the Bay du Nord Group, south of Victoria River.

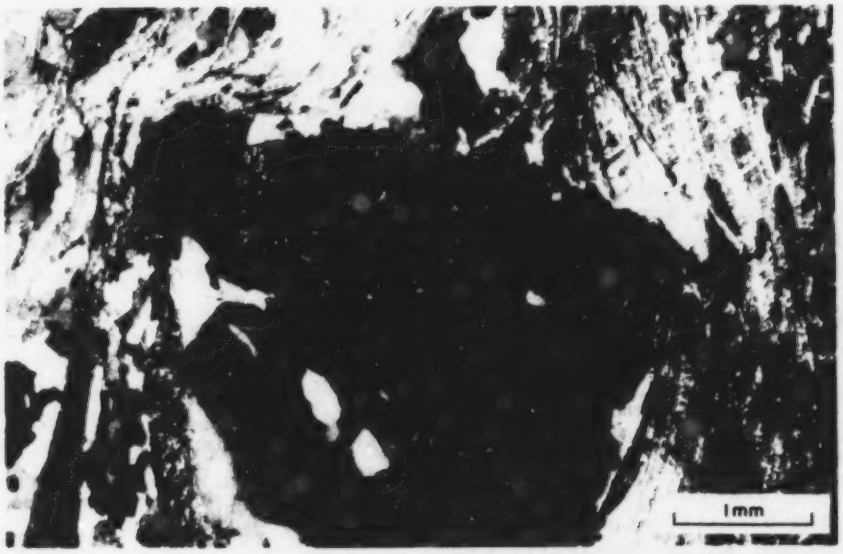


Plate 9: Garnet with quartz inclusion trails and corroded margins which forms augen in mica schists of the Bay du Nord Group, south of Victoria River.

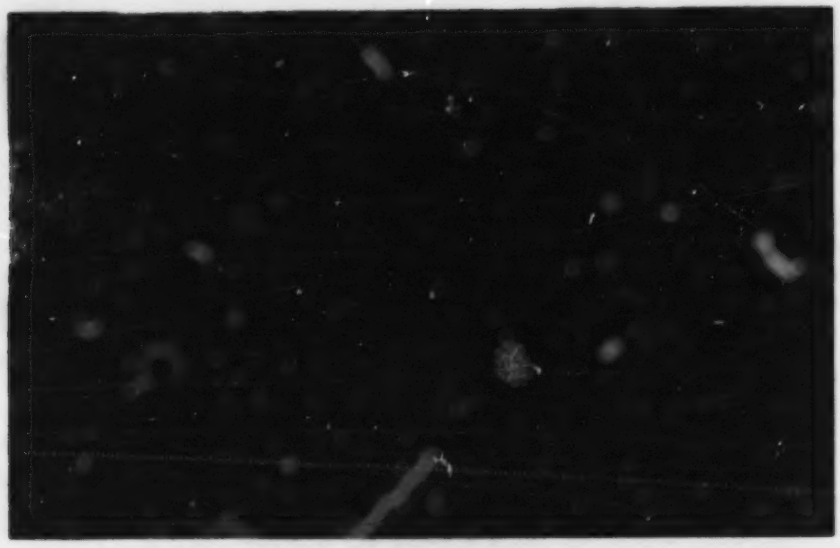


Plate 10: Psammitic and semipelitic metasediments of the Bay du Nord Group, Buck Lake Quarry, Burgeo Road. Intruded by Buck Lake Granite. Note veinlets and stringers of granite.

the psammite and the amphibolite occur throughout the migmatite and granite terrain and are indicated on the map, where scale will allow. These subunits are best exposed southeast of Princess Lake.

Lithology

Semipelitic to psammitic metasediments, gneiss and mica schist are the predominant rock types in subunit 8c. The subunit also contains minor interlayered quartzite, amphibolite and rare calc-silicate rocks. The metasedimentary rocks are generally pale gray and medium grained with a thin (1 mm - 1 cm) banding and/or bedding (Plate 10). They grade into semipelitic and psammitic paragneiss with a pronounced 'pinstripe' or millimetric banding produced by alternating quartzofeldspathic and biotite(±muscovite)-rich layers. The psammites are generally pale gray, fine grained and commonly contain amphibolite bands 4 to 25 cm thick. Rare, narrow calc-silicate bands, commonly containing distinct prismatic crystals of anthophyllite up to 15 cm long, are locally interlayered with the psammite. Mica schists, consisting predominantly of biotite and locally muscovite are a common rock type and are generally interlayered with or contain 2-10 cm wide intercalations of psammite and quartzite. The schists are coarse grained and commonly contain large euhedral garnet, staurolite and cordierite, particularly near granitic intrusions. Euhedral cordierite crystals (<2 cm) have developed in the schists and calc-silicate rocks. Garnet-quartz bands and veins are locally developed.

Quartz veins, knots and lenses are common. Thin veinlets of quartz, quartz-feldspar, and granite, commonly parallel to the banding, may represent sweats or partial melts. Granite sheets similar to the Buck Lake Granite (Unit 13) folded with the enclosing rocks, are locally present.

Subunit 8d consists predominantly of foliated amphibolite. It is generally gray to black and in places has a white mottled texture. The amphibolite is fine to medium grained, locally coarse

grained, and is composed mostly of hornblende. Locally, tremolite-actinolite schists are developed. Semipelitic and psammitic gneiss are interlayered with the amphibolite. Folded granite sheets, quartz veins and muscovite-garnet pegmatites intrude the amphibolite. In the area south of Peter Strides Pond, amphibolite occurs mainly as xenoliths within granites and migmatites.

Petrography

The semipelitic and psammitic metasediments and gneisses consist of alternating quartzofeldspathic and micaceous bands. The quartzofeldspathic bands are up to 3 mm wide and generally constitute 60 to 70 per cent of the rock. They consist predominantly of quartz and lesser feldspar (plagioclase > microcline) with a grain size that varies from <0.1 to 0.4 mm. The quartz generally has undulose extinction and sutured and embayed grain boundaries. Subgrain boundaries are well developed in the the larger crystals. In areas of close proximity to intrusions, the quartz shows an incipient to well developed polygonal to granoblastic texture. The quartz and feldspar generally have a poorly to well developed preferential orientation parallel to the banding. Biotite and minor muscovite occur as preferentially oriented intergranular flakes. The micaceous bands are up to 1 mm wide and consist of brown biotite and minor muscovite with subsidiary quartz and feldspar. The micas define a foliation parallel to the banding. The biotite generally ranges up to 1 mm in length. The banding and foliation go around fold closures and in places are transposed by a biotite-defined schistosity axial planar to the folds. Quartz veins, generally oriented parallel to banding, consist of coarse grained, linear or lensoid, undulose quartz with subgrain boundaries. Iron oxides are common as an accessory mineral.

The mica schists consist of medium grained, anhedral, elongated quartz and feldspar with an average grain length of about 0.3 mm. There are bands of coarse quartz, minor feldspar and minor mica flakes with a grain size up to 2 mm. Undulose extinction and embayed and sutured grain boundaries are commonly developed in the quartz; subgrain boundaries are well developed in the coarse grained bands. Incipient to well developed polygonization is characteristic of these rocks. Oriented, coarse grained, green-brown biotite and muscovite occur as intergranular flakes and in places form thin micaceous bands. The biotite averages 0.6 mm in length, but reaches up to 4 mm; the muscovite varies in length from 0.08 to 1 mm. Plagioclase is the predominant feldspar, although microcline is locally common. Staurolite and garnet porphyroblasts overgrow the fabric and commonly contain straight inclusion trails. The fabric, however, generally forms small augen around the porphyroblasts. Staurolite generally parallels the fabric and attains lengths up to 7 mm. The garnet crystals have a grain size up to 2 cm. Iron oxide and zircon occur as accessory minerals.

The amphibolites consist of euhedral to subhedral, granular to elongate, green-brown hornblende defining a crude to moderate fabric. The hornblende is commonly simply twinned and is locally altered to chlorite and/or actinolite-tremolite. Its grain size varies from 0.3 to 0.6 mm. Plagioclase and quartz occur as equigranular anhedral grains (0.3 to 0.5 mm), intergranular to the hornblende and have no preferred orientation. Sphene is a common accessory mineral.

Calc-silicate rocks consist of large, randomly oriented, biotite crystals up to 7 mm long and large radiating fibrous and prismatic anthophyllite crystals that are locally altered to talc. The anthophyllite

crystals are up to 15 mm long. Plagioclase and quartz constitute the felsic minerals. They vary from anhedral to subhedral, grain boundaries are generally embayed and locally a granoblastic texture has developed. Large cordierite crystals (>2 cm) and euhedral garnet (<3 mm) overgrow and contain extensive inclusions of quartz, biotite and rare anthophyllite with pleochroic halos.

Structure and metamorphism

The most common structures in these rocks are the northeast striking, moderately to steeply southeast dipping compositional banding (gneissosity) and associated foliation. The gneissosity is defined by quartzofeldspathic and mafic layers that are interpreted to parallel and amplify original bedding. The associated foliation is generally co-planar with the banding and is probably a composite fabric. This foliation is mainly defined by biotite, although quartz is locally elongated in the plane of the schistosity. In fold closures, a foliation defined by biotite and paralleling the compositional banding is folded. It is either transected or transposed by a second schistosity, which is also generally defined by biotite. In some areas the transposition of the early foliation is almost complete. The second foliation is axial planar to tight to isoclinal folding of the banding (gneissosity) and is the regionally developed foliation. It is interpreted to be related to the main period of deformation. The associated folds are predominantly moderately to steeply northeast plunging; however, southwesterly plunges were observed locally.

Granite sheets cut the paragneiss and are folded together with the enclosing host. Quartz veins and granite sheets which lie either parallel or subparallel to the banding are extensively boudinaged. In a few outcrops Type 3 fold interference patterns (Ramsay, 1967) were observed.

A set of north to northwest trending open folds, kink bands and minor shear zones postdates the northeasterly structures, and late ptygmatic folding is common.

The mineral assemblage of these rocks suggests metamorphism in the upper greenschist (?) - lower amphibolite facies. The presence of late garnet, staurolite and cordierite porphyroblasts overgrowing a biotite (+ muscovite + quartz) fabric, generally in spatial relationship to intrusive bodies, suggests thermal metamorphism. The fabric generally forms augen around the porphyroblasts.

Contact relationships

Subunit 8c is separated from rocks of the Windsor Point Group by a fault, a splay of the Cape Ray Fault system. Subunit 8d occurs as layers and units within subunit 8c. Both subunits grade into migmatite (subunit 8e) to the south. Rafts and xenoliths of subunits 8c and 8d occur throughout the migmatite terrain. The subunits are intruded by granitoid of Unit 10.

Migmatite (Subunit 8e)

Definition and distribution

Subunit 8e forms a northeast trending belt extending from the southern border of the map area, near Rocky Ridge Pond, through the center of the map area to Peter Strides Pond. It grades into and contains extensive xenoliths of subunits 8c and 8d in the west and is intruded by granites in the south and east. It consists of massive to banded migmatites and minor related rocks. Representative outcrops of the subunit occur in roadcuts and quarries along the Burgeo Road.

Lithology

The subunit consists of complexly folded, pale gray, medium to coarse grained migmatite. The migmatite has a

banding that is predominantly nebulitic but locally crudely to moderately regular or layered. The banding is generally discontinuous and varies in thickness from 1 to 20 mm. The bands generally have irregular and diffuse boundaries but in some outcrops they are continuous and sharp and impart a "pin-stripe" gneissic appearance to the migmatite. The bands are defined by leucocratic quartzofeldspathic bands alternating with melanocratic mafic, generally biotite-rich, bands. The melanocratic biotite-rich bands or layers are discontinuous and generally have nebulous boundaries. They form schlieren (restite) and biotite selvages within the quartzofeldspathic leucosome; the latter displays intrusive or cross-cutting relationships to the melanocratic layers (Plate 11). The melanocratic zones consist of biotite, minor garnet, quartz, feldspar and rare sillimanite. The biotite, locally with minor muscovite, also defines a foliation parallel to the banding. Discontinuous quartz veins are locally present. They are generally oriented parallel to the banding and are boudined and folded.

Numerous rafts and xenoliths of paragneiss occur within the migmatite terrain and appear to increase in prominence to the northwest toward the contact with subunits 8c and 8d. Angular, lenticular and generally disoriented blocks of semipelitic, psammitic and amphibolitic paragneiss floating in the quartzofeldspathic leucosome characterize these outcrops (Plate 12). Locally, the blocks are strongly impregnated with the leucosome, and a strongly banded migmatite with paragneiss bands up to 1 m wide is developed. In general the paragneiss rafts are disoriented with respect to the enclosing leucosome, which generally forms augen around them. Both are folded and have an associated axial planar foliation defined by biotite.

The migmatites have a granodioritic to tonalitic composition and locally grade into large scale banded to massive granodiorite (Unit 12). They are cut by a profusion of sheets of deformed and undeformed granite and granodiorite that may locally constitute 75 per cent of the outcrop; these are particularly common in the southern areas of the subunit. The sheets range in width from <1 cm to a few tens of metres. The deformed sheets are postmigmatitic but were folded and foliated during the folding of the migmatite. They consist of fine grained red granite, and white and pink, medium grained, equigranular and K-feldspar-megacrystic granite. Diabase dikes are locally present. Garnetiferous leucogranite is also locally present. Late, undeformed, red, white, and pink equigranular granite, rare pegmatite and leucogranite occur locally.

Cataclastic textures are locally developed in the migmatites east and southeast of Rocky Ridge Pond.

Petrography

The leucocratic bands consist of medium to coarse grained, anhedral quartz, anhedral to euhedral feldspar, minor biotite and rare muscovite. The quartz generally forms anhedral 2-3 mm grains with undulose extinction, partially developed subgrain boundaries, and irregular, embayed and sutured grain boundaries. The feldspar is mostly oligoclase to sodic andesine with an average grain size of 0.6 mm. The feldspar is generally fresh with local moderate saussuritization. Myrmekite is locally developed. In places, the quartz and feldspar are preferentially oriented and they define a fabric. Partly developed polygonal textures are also present. Feldspar with simple or single Carlsbad twins is a minor constituent and is probably orthoclase. Brown pleochroic biotite is the principal mica and forms crystals 0.3 to 0.8 mm long that are variably altered to chlorite. Together with subordinate muscovite, it locally forms a poorly developed foliation parallel to the banding. The micas also occur in an unoriented mode.

Plate 11: Migmatite, Bay du Nord Group Burgeo Road. Biotite rich paleosome in a granodioritic neosome.

Plate 12: Angular and partially resorbed blocks of paragneissic paleosome float in a nebulitic leucosome of granodiorite, Bay du Nord Group, west of Princess Lake.

The melanocratic bands consist of extensive brown biotite and minor quartz and plagioclase. Minor chlorite after biotite, rare, randomly oriented, green hornblende and minor muscovite are lesser constituents. Muscovite occurs parallel to the banding, as disoriented flakes, and locally overgrows the biotite. Biotite generally defines a foliation; however, randomly oriented biotite also occurs. The biotite crystals vary from <0.4 to 3 mm long but in places are very coarse, up to 1 cm. Locally the biotite appears to have been recrystallized and mimics an earlier fabric. Sillimanite, which is strongly altered and surrounded by sericite and muscovite, occurs as aggregates which may be >7 mm long. It also occurs with biotite, muscovite, plagioclase and microcline in biotite-rich zones within the leucocratic bands. The quartz generally occurs as anhedral grains with undulose extinction, embayed and sutured grain boundaries and partly developed subgrain boundaries. In places however, locally partly polygonized and linear, elongate crystals are developed. Large euhedral garnets up to 3 mm in diameter are locally present, in particular in the biotite rich-layers. They overgrow the fabric and contain inclusions of fine grained, randomly oriented quartz and biotite. Fine grained veinlets or sweats consisting of quartz, microcline and plagioclase are locally present. Zircon and iron oxides are the main accessory minerals.

The banded migmatites have essentially the same mineralogy and texture as do the nebulitic rocks; however, the quartz locally defines a strong foliation in the strongly banded migmatite.

Structure and metamorphism

A prominent gneissosity that varies from a schlieren (nebulite) to a well developed banding characterizes the migmatites. It has a northeasterly trend with moderate to steep dips. The development of this gneissosity is largely controlled by its migmatitic history and is probably mimicking original bedding or a banding produced during an earlier deformation period. The gneissosity is defined by coarse bands of leucocratic granitic material alternating with generally discontinuous and nebulitic, melanocratic, biotite-rich areas. In the banded migmatites, the boundaries on a mesoscopic scale are sharp, while in the schlieren or nebulitic migmatite, they are generally diffuse and irregular. An early foliation, which is defined by the biotite and which parallels the gneissosity, is preserved in the melanocratic bands and is folded with the gneissosity. A strong penetrative fabric is superimposed upon the gneissosity and the early foliation. The second fabric is northeasterly trending and, steeply dipping; it is defined by biotite and in places by muscovite and elongated quartz. This foliation is axial planar to tight to isoclinal, variably northeast and southwest plunging, minor folds of the gneissosity. It also overprints the granodiorite and most of the granite sheets within the migmatites. In the extreme south of the area, in particular east of Rocky Ridge Pond, the foliation grades into or is overprinted and obliterated by a weak to strongly developed northeast trending mylonitic foliation. In places garnets are abundant and overprint the biotite. Sillimanite occurs locally in biotite-muscovite-rich zones within the leucocratic bands.

A set of west-northwest to northwest trending open folds, kink bands and minor shear zones postdates all of the above structures.

The mineral assemblage in these rocks suggests that the peak metamorphism of these rocks occurred under upper amphibolite or higher facies conditions.

Contact relationships

Subunit 8e locally grades into granodioritic rocks of Unit 12. Unit 12 also shows intrusive relationships to

the migmatite. Subunit 8e is intruded by the Buck Lake Granite (Unit 13). To the north the migmatite grades into the metasediments and paragneiss of subunits 8c and 8d.

ROGERSON LAKE CONGLOMERATE(?) (UNIT 9)

Definition and Distribution

The name Rogerson Lake Conglomerate was formally proposed by Kean and Jayasinghe (1980) for the distinct, narrow, northeast trending belt of conglomerate and sandstone extending from Rogerson Lake in the southwest to Sandy lake in the northeast. It has a strike length of over 80 km. Mullins (1961) mapped a part of the sequence in the Noel Paul's Brook area and informally called it the Lake Ambrose Formation. However, since it is not exposed on Lake Ambrose and is generally poorly exposed in that map area, the name Rogerson Lake Conglomerate was proposed. A more deformed and gray to red, but otherwise similar conglomerate occupies an identical stratigraphic position in the Victoria Lake and King George IV Lake map areas. This conglomerate is also assigned to the Rogerson Lake Conglomerate.

Mullins (1961) considered the conglomerate to overlie unconformably the Tally Pond volcanics. Williams (1970) interpreted the volcanics and conglomerate to be a continuous sequence of Silurian age. Kean (1977) originally considered the conglomerate to be interbedded with sediments that were interpreted to overlie conformably the Victoria Lake Group and that are lithologically similar to subunit 8a of the present map area. However, subsequent work by Kean in the Victoria Lake map area has shown that the conglomerate unconformably overlies the Valentine Lake quartz monzonite which intrudes the Victoria Lake Group.

Age and Correlation

The Rogerson Lake Conglomerate is considered Middle Ordovician or younger in age since in the Lake Ambrose area it stratigraphically overlies, and contains clasts of, rocks interpreted to have been derived from the Middle Ordovician and older Tally Pond volcanics of the Victoria Lake Group. It also contains clasts of the Valentine Lake quartz monzonite that intrudes the Victoria Lake Group in the Victoria Lake map area (Kean and Jayasinghe, 1980). Williams (1970) considered the Rogerson Lake Conglomerate to be continuous with the Botwood Group thus implying a Silurian age for the conglomerate. Kean and Mercer (1981) were unable to demonstrate a continuous outcrop link with the Botwood Group but suggested the conglomerate was of similar age. Alternatively, the conglomerate may be the equivalent of the Silurian Goldson Conglomerate of Notre Dame Bay.

Unit 9

Definition and distribution

Conglomerate and interbedded sandstone of Unit 9 occupy a northeast trending, 1.5 km wide belt in the north-central part of the map area. It extends from Wood Lake in the southwest to Victoria Lake in the northeast. The unit is highly deformed and is correlated with the Rogerson Lake Conglomerate on the basis of lithology and stratigraphic position.

Representative exposures of the unit are along the Burgeo Road and in the northeast trending ridge north of Victoria River.

Lithology

Unit 9 consists mainly of gray to purple, locally red, deformed polymictic conglomerate (Plate 13). Intercalated with the conglomerate are beds and lenses of gray and/or red, coarse to medium grained sandstone and conglomeratic sandstone up to 1 m thick. Locally, particularly in the northern portion of the unit, the sandstone predominates. The conglomerate consists primarily of subrounded to rounded clasts of felsic and mafic volcanic rock, red chert, and rare granite, and

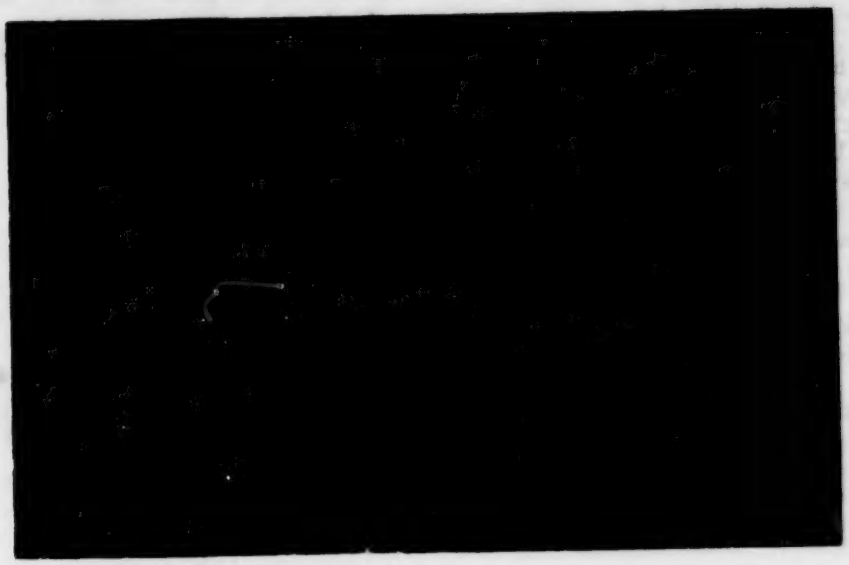


Plate 13: Highly deformed conglomerate of Unit 9, Victoria Lake.

elongate or linear disk-shaped clasts of siltstone, argillite and sandstone. Large, rounded, milky quartz clasts are common in places. Clasts within the conglomerate vary from a few millimetres to tens of centimetres. The clasts are more flattened and attenuated and mortar structure is developed to the south, with proximity to a major fault. Quartz veining is generally extensive.

Petrography

The conglomerate and conglomeratic sandstone generally contain abundant lithic and rounded quartz and feldspar clasts. The lithic clasts generally predominate in the conglomerates. Cryptocrystalline (devitrified?), feldspar-microlitic basalt is a common lithic clast; highly altered, medium grained basalt is locally present. Clasts of felsite and felsic volcanics are less common, whereas granite and quartz-feldspar porphyry fragments are minor. Sedimentary rock clasts are very common and are generally platy or elongate; they generally have wispy ends suggesting incorporation while soft or partly lithified. The sedimentary clasts are generally fine grained argillite, siltstone, sericitic mudstone and graphite-rich shales. Rounded epidote grains occur in places. Clast size varies from <0.2 mm to tens of centimetres.

The sandstone and the matrix to the conglomerate consist of moderately to well sorted sand to locally silt size clasts. The matrix consists mostly of fragments of strained quartz with undulose extinction; feldspar is the next most common constituent. Lithic fragments (<0.1 - 0.7 mm) and rare epidote grains are minor constituents. Sericite is also a common constituent in the matrix. Calcite is fairly common and in places there is abundant pyrite. Hematization of the matrix and some of the clasts ranges from incipient to extensive.

Structure and metamorphism

Unit 9 possesses a well developed regional foliation that is mainly defined by sericite and by the alignment of clasts. It generally forms augen around clasts and locally 'crush-

textures' are developed. Neither minor nor regional fold structures were delineated. The deformation, as evidenced by the foliation, is more strongly developed in the southern part of the unit. There, in close proximity to a fault, the clasts in the conglomerate are strongly flattened and attenuated; shearing and slickensiding are also common in this area and crushed as well as rolled grains are present.

The unit has been metamorphosed under greenschist facies conditions.

Contact relationships

The contact with Unit 8 to the south is not exposed, but is interpreted to be a fault-modified unconformity.

The contact with the Victoria Lake Group (Unit 7) is likewise not exposed in the map area. Extensive shearing, slickensides and cataclasis suggest that it is a fault.

Deformed Granite and Granodiorite (Unit 10)

Definition, division and distribution

Unit 10 is a deformed, generally cataclastic, granitoid intrusion occuring as two linear bodies trending northeast-southwest across the center of the map area. They are separated from each other by rocks of Unit 8. The southwesterly body extends from the southwestern corner to the center of the map area where lack of outcrop prevents its further delineation. The regional aeromagnetic pattern (G.S.C., 1968) indicates that the body terminates there. The other body extends from Wood Lake, northwestward along the north side of Peter Strides Pond into the Puddle Pond (12A/5) area and thence northward into the Victoria Lake (12/6) area; there it occurs mainly as xenoliths within moderately deformed to undeformed granites (Kean, 1976, 1977). The intrusion was emplaced in rocks of Unit 8 subsequent to migmatitization. The unit is comprised of gray granodiorite and red to pink granite; where they are divisable into mappable subunits, they are designated as subunits 10a and 10b respectively.

U/Pb dating of similar 'gneissose' (mylonitized) granitoids in the Victoria Lake map area yielded an age of 389 + 20 Ma (Dallmeyer, 1981). Kean (1976) originally interpreted these granitoid rocks in the Victoria Lake map area to be intrusive into the deformed metasedimentary terrain and to be Devonian or older. However, Kean (1977) subsequently re-interpreted them as remobilized gneisses that probably originally represented sialic basement that had been migmatized during the emplacement of late granites. Representative exposures of the unit occur on the ridge between Victoria River and Peter Strides Pond.

Lithology

This unit consists of deformed gray, medium grained, equigranular biotite granodiorite (10a) and deformed, red and pinkish white, medium to locally coarse grained, equigranular granite (10b) (Plate 14). Dioritic phases are locally present.

The granodiorite contains biotite and rare hornblende; locally muscovite is present. In places, the granodiorite has a distinct millimetre scale mineral (compositional) banding defined by coarse mica, mostly biotite, and quartzofeldspathic layers, that imparts a 'pin-stripe' gneiss characteristic to these rocks. This banding is very fine grained, ranging up to a maximum thickness of 2 mm (Kean, 1977).

Biotite and muscovite are both present in the granite. The muscovite generally forms a minor constituent, although its content locally equals biotite. Narrow zones of high strain, characterized by cataclastic textures, separated by less deformed zones, are well developed in the granites. Dispersed primary garnets are locally present.

Plate 14: Cataclastic fabric developed in granite of Unit 10, Burgeo Road.

Petrography

The granites consist of quartz (30 per cent), K-feldspar (30 per cent), plagioclase (20 per cent), biotite (10 per cent), muscovite (1 to 10 per cent), and accessory minerals, principally zircon, apatite, iron oxides and sphene (Table 2). Sericite, chlorite and calcite occur as secondary minerals. A hypidiomorphic-granular texture is preserved in the undeformed or weakly deformed zones of the granites.

Quartz occurs as anhedral interstitial grains 1.5 to 3 mm in size. It generally has undulose extinction and subgrain boundaries are commonly developed. Elongate 'ribbon' quartz, rounded quartz and fine grained recrystallized quartz ($\leq$0.2 mm) and feldspar are particularly well developed in the zones of high strain and cataclasis. The K-feldspar forms anhedral to subhedral, generally fresh, microcline crystals that are perthitic in places. Plagioclase generally occurs as anhedral to subhedral, albite-twinned, oligoclase crystals that are slightly sericitized. Rounded grains of feldspar and fractured feldspar with granulation and displacement along the fractures are present in the deformed domains. Crush-trails are locally developed on the feldspar. Biotite defines a generally anastomosing fabric that forms augen around the quartz and feldspar crystals. The biotite is locally altered to chlorite. Muscovite forms up to 10 per cent of the rock; it generally occurs intergrown with the biotite.

The granodiorites generally possess textural and deformational aspects similar to the granites. Biotite is more extensive and is generally more chloritized. Muscovite is rare and minor green hornblende is locally present. The plagioclase is of basic oligoclase - sodic andesine composition. In the highly deformed zones, cataclastic textures such as fractured and fragmented feldspar porphyroblasts, 'crush-trails' granulated quartz and feldspar, 'ribbon (flamboyant) quartz' (cf. Higgins, 1971) and biotite streaks are developed. The banded granodiorites consist of 0.5 mm wide biotite-rich bands and quartzofeldspathic bands up to 2.5 mm in width. The biotite is up to 1 mm long and is elongate parallel to the

banding. In the quartzofeldspathic bands the quartz is strained, grain boundaries are embayed and sutured, subgrain boundaries are partly developed and extinction is undulose. The quartz commonly is elongate and defines a weak foliation. It generally also shows incipient recrystallization and polygonization.

Structure and metamorphism

A characteristic feature of Unit 10 is a strongly developed, steeply dipping, penetrative fabric. The fabric is predominantly a foliation (S-fabric) but locally is characterized by a mineral lineation (L-fabric). The foliation is defined by biotite, minor muscovite and quartz, and commonly forms augen around the feldspar. The quartz in places has a "ribbon-texture" and anastomosing pattern suggesting a mylonitic texture. The biotite (+muscovite) foliation planes are often spaced up to 5 mm apart, separated by zones with a less strongly developed foliation.

The foliation is probably composite in many places, but a strong cataclastic component is generally recognized.

Contact relationships

Unit 10 intruded the rocks of Unit 8 subsequent to the formation of the gneissic banding and migmatization. It contains numerous xenoliths of amphibolite, psammite and semipelite of Unit 8 and dikes and apophyses of it truncate the banding. Rocks of Unit 8 that are in close proximity to Unit 10 are metamorphosed under amphibolite facies conditions. Metamorphic minerals in the contact aureole include staurolite and cordierite; they overgrow an earlier fabric which subsequently formed augen around them. It is intruded by undeformed, equigranular and K-feldspar porphyritic granite, red granite and aplite similar to phases associated with the Buck Lake Granite (Unit 13).

TABLE 2: Modal composition of intrusive rocks in the map area.

UNIT	10b	11a	11b	11c	11d	11e	12	13a	13b	13c	16a	16c
N	2	3	3	3	3	2	5	7	6	2	2	2
Quartz	30	3	24	64	38	37	42	30	30	45	40	35
Plagioclase	20	33	44	29	18	25	40	37	29	15	14	15
K-feldspar	30	–	–	0.5	28	30	1	17	29	28	41	41
Biotite	10	6	9	3	3	7	16	11	10	8	<1	8
Muscovite	1-10	–	–	–	–	–	–	–	–	3	3	–
Hornblende		32	20	2	5	–	–	3	–	–	–	–
Garnet		–	–	–	–	–	–	–	–	–	<1	–
Accessories		27	3	<2	7	1	1	2	2	1	1	1

Note: N = number of samples point-counted.

Lloyds River Intrusive Suite (Unit 11)

Definition, division and distribution

The name Lloyds River Intrusive Suite is a new name proposed for an undated suite of gabbro, diorite, tonalite, granodiorite and granite that forms a linear northeast trending belt across the northwest corner of the map area. It extends from south of Lloyds River to the northern boundary of the map area. It is bounded to the northwest by the Cormacks Lake complex (Unit 1) and to the southeast by the Windsor Point Group (Unit 15). Parts of the unit, e.g. subunit 11d, lithologically resemble the Cape Ray Granite (D. Wilton, personal communication, 1981).

The suite is divided into five subunits. Subunit 11a is a mafic phase of apparent limited extent that consists of medium grained hornblende gabbro and diorite and forms the western margin of the suite. Subunit 11b is a medium to coarse grained quartz diorite and tonalite that borders the mafic phase to the north and that is intrusive into it. Subunit 11c is a medium grained, quartz-rich granodiorite phase bordering 11b to the east. It is exposed between the southwest and northwest trending arms of King George IV Lake. A coarse grained to porphyritic hornblende-biotite granitic phase forming the bulk of the suite is assigned to subunit 11d. It forms the eastern margin of the suite south of King George IV Lake. Subunit 11e is a medium grained to locally megacrystic biotite granite (subunit 11e) underlying the area north of King George IV Lake. The mafic phases are intruded by the more felsic rocks; in places there appears to be a composition gradation from granodiorite to granite.

The suite is best exposed along the northwest arm of King George IV Lake, along Lloyds River and in the ridges of Princess Lake Brook.

Lithology

The mafic phase (subunit 11a) of the Lloyds River Intrusive Suite is a medium grained (1 to 5 mm), equigranular, dark colored, or mottled black and white, hornblende gabbro and diorite. Areas of coarse grained hornblende crystals are locally developed. The rock is generally unfoliated but locally there is a weak fabric defined by hornblende. Diabase dikes up to 1 m wide are present in places. Epidote patches and/or veins are locally common.

The tonalitic rocks (subunit 11b) are generally medium grained (1 to 3 mm), equigranular and dark gray or black and white mottled. They generally have a strong L-fabric defined by hornblende; locally, e.g. near the contact with Unit 1 a cataclastic texture is developed. They are intruded by granodioritic and granitic rocks of subunits 11c and 11d; however, they locally appear to grade into more leucocratic and quartz-rich rocks similar to those of subunits 11c and 11d. They intrude and contain xenoliths of the mafic phase (11a) along its eastern contact. In hand specimen, they appear to be composed almost entirely of plagioclase and hornblende.

Rocks of subunit 11c are medium grained to locally coarse grained, white, equigranular, biotite- and hornblende-bearing, quartz-rich granodiorite/tonalite. They vary from being undeformed to locally weakly to moderately foliated. In a few outcrops, a widely spaced, weak, northwest to north trending penetrative S-fabric is developed. Xenoliths of paragneiss and deformed gabbro and diorite, probably belonging to the Cormacks Lake complex, are locally present.

Subunit 11d includes coarse grained to megacrystic and K-feldspar porphyritic granodiorite and granite. The subunit is generally gray to buff in

color, and is characterized by large, distinctive, pink to red, euhedral K-feldspar megacrysts or phenocrysts; the latter are diagnostic of the exposures along the contact with the Windsor Point Group. K-feldspar averages 1 to 2 cm in length and locally is up to 4 cm. Green, altered euhedral plagioclase crystals and phenocrysts are also characteristic of this rock type. Epidote veining is locally developed. Tuffisites or gas breccias, shearing, and extensive calcite and quartz veining are developed in the contact area with the Windsor Point Group. In the same area K-feldspar crystals and crystal fragments and quartz crystals in a fine grained, epidote- and sericite-rich, altered, green matrix are characteristic the subunit in this area. A boulder of this highly altered facies contains Zn-Pb-Au-bearing quartz veins (see economic section). The subunit varies from undeformed to locally deformed and both S and L fabrics are developed. In hand specimen rocks of this subunit appear to be composed entirely of white and red K-feldspar, green altered plagioclase, quartz, and chloritized hornblende.

Subunit 11e consists of medium to coarse grained, equigranular to K-feldspar megacrystic granite. Biotite is the predominant ferromagnesian phase. The granite lacks the distinctive red K-feldspar crystals and local intense alteration characteristic of subunit 11d.

Petrography

The average modal analysis from three thin sections of the gabbro from subunit 11a is plagioclase (33%), hornblende (32%), biotite (6%), quartz (3%), and accessory minerals (27%). The accessory minerals include primary sphene, opaques, apatite and secondary chlorite, epidote, clinozoisite, calcite, sericite and quartz. The secondary minerals, in particular epidote and chlorite, constitute most of the accessory phases. Texturally the gabbro varies from ophitic and locally poikilitic to intergranular and subophitic. Plagioclase is andesine ($<An_{50}$) and forms euhedral, stumpy and tabular crystals up to 3 or 4 mm across but generally <1.5 mm. Abundant albite and combined Carlsbad-albite twins are developed. The plagioclase is variably saussuritized and sericitized and in places checker-board albites are developed. The angular interstices between the feldspars are occupied by epidote, chlorite, minor calcite, hornblende and biotite. Chlorite generally appears to be replacing hornblende and biotite. Hornblende occurs as green pleochroic crystals averaging 2 mm. The biotite forms long, slender and bent or kinked crystals, generally <1 mm; these are invariably altered to chlorite, in places with anomalous blue to purple interference colors. Quartz occurs as minor anhedral interstital grains.

The mode of the tonalite in subunit 11b, based on an analysis of three thin sections, is plagioclase (44%), quartz (24%), hornblende (20%), biotite (9%), and accessories (3%). The accessory minerals include primary apatite, sphene, opaques (iron oxides) and minor orthoclase, and secondary epidote, sericite, chlorite and calcite. The quartz occurs as anhedral interstitial grains with common inclusions of biotite, hornblende and plagioclase. In many places extinction is undulose, grain boundaries are lobate and subgrain boundaries are developed. The grain size is about 1 mm. Plagioclase forms subhedral to euhedral crystals 0.5 to 2.5 mm long; albite and Carlsbad-albite twins are common and normal zoning is locally present. The plagioclase has a bulk composition of An_{40-48}. Plagioclase saussuritization varies from incipient to moderate. Rare anhedral interstitial grains of orthoclase are also present. Green to brown pleochroic hornblende forms anhedral to subhedral grains up to 0.8 mm in size. It is commonly simply twinned and is variably chloritized. Brown pleochroic biotite, forming crystals 0.2 to 0.8 mm long, generally

occurs in aggregates with hornblende and is chloritized. The proportion of biotite to hornblende is variable; the two generally constitute 30 per cent of the rock with hornblende predominating.

The rocks of subunit 11c have a mode of 64% quartz, 29% plagioclase, 3% biotite, 2% hornblende and approximately 2% accessories. Their composition is that of a quartz-rich tonalite. Accessory minerals include primary orthoclase (<0.5%), rare muscovite, sphene and iron oxides, and secondary chlorite and alteration products of plagioclase. Quartz occurs as large, (0.4 to 4 mm), locally fractured anhedral interstitial grains that display undulose extinction and subgrain boundaries. Plagioclase forms subhedral to euhedral, albite and Carlsbad-albite twinned crystals of oligoclase (An_{16-24}) that vary from 0.8 to 2.5 mm in length. Graphic orthoclase occurs in places while elsewhere orthoclase occurs as untwinned, dusty, anhedral grains. Green hornblende and chloritized brown biotite occur as intergranular minerals; their relative proportions are variable. The hornblende forms anhedral to subhedral crystals up to 0.6 mm in size. Biotite flakes are up to 0.8 mm long but average 0.4 mm.

The rocks of subunits 11d and 11e have a hypidiomorphic-granular texture. The absence of hornblende, the generally less altered nature of the K-feldspar and plagioclase, and the predominance of microcline distinguishes 11e from 11d. The mode of subunit 11d, based on an analysis of three samples, is quartz (38%), K-feldspar (28%), plagioclase (18%), hornblende (5%), biotite (4%), and accessories (7-13%). Accessory minerals include primary sphene, zircon and iron oxides. Extensive secondary epidote and carbonate after plagioclase, and sericite mainly after K-feldspar, quartz and albite, are also present. Chlorite after biotite and hornblende is extensive. The mode of subunit 11e is quartz (37%), K-feldspar (microline + minor orthoclase) (30%), plagioclase (25%), biotite (7%), and accessories (1%). Apatite, zircon and iron oxide are common accessories, and sericite is a common secondary mineral.

The quartz in these subunits occurs as large, (0.5 to 6 mm) anhedral, interstitial grains that contain inclusions of plagioclase, biotite and hornblende. The quartz generally displays undulose extinction and locally is fractured. Large, euhedral K-feldspar that is untwinned or contains twins consisting of two individuals is the dominant feldspar in subunit 11d. It is commonly perthitic and graphic textures are locally developed. Crystals reach 4 cm in length but generally average between 1 and 2 cm. In places it is sericitized and contains extensive granular epidote, as well as inclusions of quartz, sericite and plagioclase. Microcline occurs as minor interstitial grains and as rare crystals in subunit 11d. However, in subunit 11e microcline predominates. It occurs as subhedral to euhedral crystals up to 5 mm in size and as subhedral interstitial grains. Perthites and graphic textures are commonly developed. Flecks of sericite occur throughout the crystals. In both subunits plagioclase occurs as subhedral to euhedral crystals of oligoclase to sodic andesine composition. It generally forms small stumpy crystals but may also occur, in particular in subunit 11d, as large, up to 5 mm, euhedral crystals or megacrysts. Albite and Carlsbad-albite twins are common; pericline twins and zoning are locally developed. The twin lamellae are locally bent or curved. The plagioclases vary from fresh with only incipient alteration to completely sericitized, in particular in subunit 11d; epidote and calcite are minor constituents. The intense alteration is particularly well developed in the megacrysts.

Hornblende is present in only subunit 11d. It occurs as subhedral to euhedral grains displaying simple twins and twin seams. It is pleochroic from pale brown and green to dark green. It

is commonly partly chloritized and in places has extensive granular epidote associated with it or replacing it. Brown biotite is the only ferromagnesian phase present in subunit 11e, and it locally predominates over hornblende in subunit 11d. It forms prismatic crystals up to 7 mm long that are in many cases bent and kinked. The biotite is unaltered to completely altered to chlorite with anomalous purple-blue interference colors. Rare primary muscovite occurs as intergranular flakes.

In the contact area with the Windsor Point Group, subunit 11d is completely altered. It consists of large, anhedral crystals of quartz with undulose extinction, sericitized and epidotized feldspar megacrysts, chloritized biotite, and abundant disseminated secondary minerals consisting of epidote, sericite, and carbonate. The secondary minerals locally form matrix to the quartz and feldspar.

Structure and metamorphism

Rocks of Unit 11 are inhomogeneously deformed. The center of the unit is generally less deformed than the margins, where shearing and cataclastic fabrics are locally developed. A moderately northeast plunging hornblende lineation is the most common penetrative fabric; however, a quartz and biotite-hornblende schistosity is locally present. On the peninsula between the northwest and southwest arms of King George IV Lake, a northwest to north trending, widely spaced fracture cleavage schistosity is locally developed. This fabric is interpreted to be related to late phase(s) of deformation rather than to the early northwest trending structures such as those seen in the Cormacks Lake complex. Northwest trending shears and faults are also locally developed. These structures may be related to a possible major fault defined by the northwest arm of King George IV Lake.

A lower greenschist facies grade of metamorphism is indicated by the presence of epidote, chlorite, calcite, sericite, quartz and albite.

Contact relationships

The Lloyds River Intrusive Suite intrudes the Cormacks Lake complex, although most of the contact is now interpreted to be a fault. Its relationship to the King George IV Lake complex is not clear; however, small plugs of a similar granite intrude the ophiolite. The suite is unconformably overlain by the upper Lower Devonian Windsor Point Group as indicated by granite and K-feldspar clasts in the basal units of that group.

Granodiorite (Unit 12)

Definition, division and distribution

Unit 12 forms a narrow band of granitoid rocks outcropping between the granitic rocks of Unit 13 and the migmatites of Unit 8. It intrudes and forms sheets within the migmatites and appears to be related to them. It is poorly exposed, and is best observed along sections of Burnt Pond Brook and in the hills west of the Burgeo Road and north of Burnt Pond Brook. The unit is divisible into phases of medium grained tonalitic and granodioritic to granitic rocks (subunit 12a) and minor or medium grained banded granodiorite (subunit 12b).

Lithology

Subunit 12a consists of gray, medium grained, biotite tonalite and granodiorite. Pink K-feldspar phenocrysts or megacrysts are patchily developed in some exposures and locally the unit is granitic, particularly in the dikes and plugs within the migmatitic terrain. Most of the subunit is characterized by stumpy (or blocky) equant plagioclase crystals suggestive of an incipient porphyritic texture in an otherwise

equigranular granodiorite. It is intruded by both undeformed and weakly foliated biotite granite and cut by aplite dikes.

Subunit 12b consists of banded granodiorite. The bands contain poorly developed, alternating melanocratic biotite-rich and leucocratic quartzo-feldspathic layers with minor biotite. The scale of banding varies from less than 3 mm to 1 m. A weak biotite foliation is locally developed.

Petrography

The rocks of subunit 12a and 12b have a mode, based on an analysis of five thin sections, of quartz (42%) plagioclase (40%), biotite (16%), orthoclase (1%), and accessories (1%). The accessory minerals include primary apatite, iron oxide and zircon and secondary sericite, muscovite, epidote, calcite and chlorite. Plagioclase forms subhedral to euhedral blocky to prismatic crystals, 0.8 to 4 mm in size, of oligoclase-andesine composition (An_{30-32}). The crystals display albite and combined Carlsbad-albite twins and the twin lamellae are in many cases bent; rare normal zoning is locally present. The plagioclase is generally fresh with only incipient sericitic alteration and minor development of epidote and calcite; however, locally the alteration is more extensive. Small round inclusions of quartz and locally biotite are common. Minor myrmekitic textures are locally developed. Orthoclase and/or microcline occur as rare interstitial grains, rarely as mantles on the plagioclase and locally as phenocrysts. Quartz occurs as anhedral interstitial grains, with undulose extinction; sutured grain boundaries are locally developed. It locally contains inclusions of biotite. Brown pleochroic biotite forms anhedral to euhedral flakes ranging in length from <0.3 to 2 mm. The biotite is variably altered to chlorite with purple interference colors. Rare muscovite occurs both as small intergranular flakes and as an intergrowth with biotite.

Structure and metamorphism

Subunit 12a varies from undeformed to moderately foliated. The foliation is defined by quartz and biotite. The main structure in subunit 12b is a banding defined by melanocratic biotite-rich layers and leucocratic quartzo-feldspathic layers. This banding is interpreted to be metamorphic although locally it could be primary. A weak biotite foliation is locally developed in this subunit.

Contact relationships

Unit 12 is intrusive into Unit 8 after migmatization and metamorphism and sheets of it are folded with the migmatitc banding. The relationship to the granitic rocks of Unit 13 is not clear although dikes of medium grained undeformed to foliated biotite ± muscovite granite similar to Unit 13 intrude Unit 12, and xenoliths of a pre-deformed granodiorite locally occur in Unit 13. Weakly foliated biotite granite, undeformed garnetiferous leucogranite aplite, tourmaline-bearing pegmatite and medium grained, biotite granite intrude subunit 12b. It is lithologically similar to parts of the pre-Devonian (?) Rose Blanche granite (L. Chorlton, personal communications, 1981), and may have a similar age.

Buck Lake Granite (Unit 13)

Definition, division and distribution

The name Buck Lake Granite is a new name here proposed for the large granite body underlying the southeast portion of the map area. The granite is poorly exposed and is best seen in the high hills east of the Burgeo Road and in quarries along the Road south of Burnt

Pond Brook. It has been divided into four subunits. Subunits 13a and 13b are K-feldspar porphyritic to locally equigranular granodiorite and biotite granite, respectively; subunit 13c is a medium grained biotite-muscovite granite and subunit 13d is gabbro and diorite. Rock types of subunit 13b predominate. The Buck Lake Granite also includes numerous unseparated (for reasons of scale) dikes and plugs of granite, aplite and pegmatite. The relationship between the subunits is not known but the contact between 13a and 13b is interpreted to be gradational. A mafic complex intruded by white and pink, equigranular granite dikes outcrops south of Burnt Pond Brook, west of the Burgeo Road and is assigned to subunit 13d, although rocks of this subunit are similar to Unit 14.

Lithology

Subunits 13a and 13b are feldspar-porphyritic, locally equigranular, gray and locally pink granodiorite and granite, respectively. The pink and white feldspar megacrysts are mostly K-feldspar although plagioclase is also common. Rapakivi textures are locally developed. The feldspar crystals are up to 3 cm long and generally impart a porphyritic texture to the rock. Although biotite is generally the only mafic constituent, where the rocks tend to be more granodioritic hornblende is locally present. This is particularly true in the equigranular granodioritic phases northeast of Peter Strides Pond. In places, hematite is common as a stain (exsolved?) on the feldspar and also along fractures.

Dikes and veins of a grayish-white, fine to medium grained, biotite granite/granodiorite intrude the K-feldspar porphyritic granite and metasedimentary rocks in Buck Lake quarry. They are folded with the enclosing rocks and have a weakly to moderately developed axial planar foliation (Plate 15).

White and locally pink, fine grained muscovite-biotite garnetiferous leucogranite dikes, tourmaline-beryl-bearing granite, coarse grained pegmatite dikes, and aplite are common. They generally show no tectonic fabric, but locally a weak foliation parallel to that in the country rocks is developed, e.g. in Buck Lake quarry. Medium grained, biotite-muscovite granite truncates the foliation in the K-feldspar porphyritic phase. A boulder

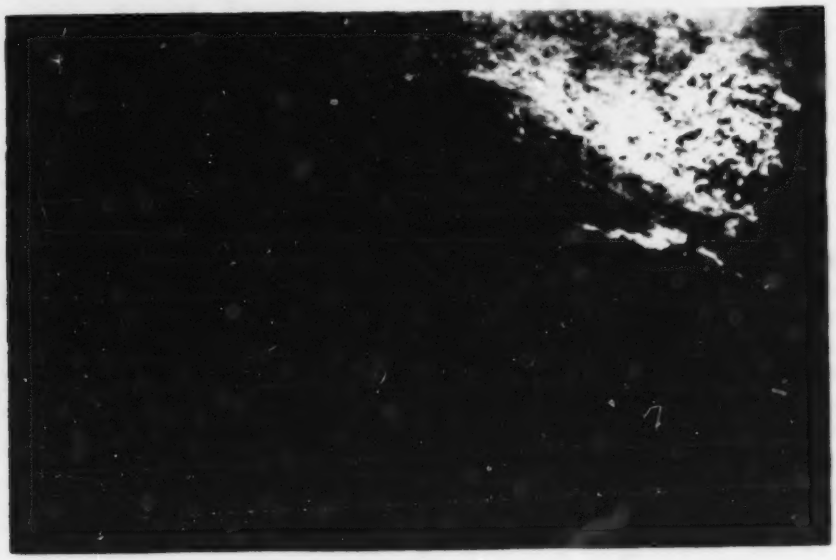


Plate 15: Folded biotite granite dike intruding the megacrystic Buck Lake Granite (top right) and metasediments of the Bay du Nord Group, Buck Lake Quarry, Burgeo Road. Pencil parallels an axial planar schistosity.

containing beryl-bearing pegmatite was noted north of Burnt Pond Brook. Fine to medium grained, pink to red granite occurs as 2 cm to 5 m wide dikes.

K-feldspar porphyritic granite dikes of the Buck Lake type are common in the metamorphic terrain of Unit 8. They have been deformed by the main deformation subsequent to migmatization.

Subunit 13c is gray to pink, medium grained, equigranular to locally K-feldspar porphyritic granite. Biotite and muscovite are both present; biotite is always predominant. Dikes of similar granite occur within Unit 12 and the migmatites.

Dark colored, fine to coarse grained, biotite quartz diorite and gabbro, in places characterized by pinkish plagioclase, constitute subunit 13d. It is intruded by fine to medium grained, pink and white granite dikes and sheets up to 5 m thick. The granite is biotite- and locally muscovite- and garnet-bearing. Xenoliths of gabbro, deformed prior to incorporation, and of a fine grained, gray, hornfelsed basic volcanic with biotite 'spots' are locally common in the granite.

Petrography

The mode of the granodioritic rocks (subunit 13a), based on an analysis of seven thin sections, is plagioclase (37%), quartz (30%), K-feldspar (17%), biotite (11%), and hornblende (up to 3%). The mode of the granites of subunit 13b, based on an analysis of six thin sections, is quartz (30%), K-feldspar (29%), plagioclase (29%), biotite (10%) and accessories (2%). The accessory minerals include subhedral to euhedral rhombic sphene, apatite, zircon, iron oxides, rare muscovite and locally minor hornblende and minor secondary minerals such as chlorite, sericite, calcite and epidote. Quartz occurs as euhedral, interstitial undulose grains, up to 1.5 cm long, that generally have sutured and subgrain boundaries. In places quartz contains minor inclusions of biotite. Microcline varies from anhedral interstitial grains to euhedral prismatic megacrysts up to 3 cm long. They are strongly perthitic, possess quadrille twinning and vary from fresh to moderately altered. Inclusions of biotite and plagioclase are locally present and graphic textures are generally common. Orthoclase occurs as a rare intergranular mineral. Simply twinned alkali feldspar megacrysts or phenocrysts may be orthoclase. Plagioclase occurs as subhedral to euhedral, blocky to prismatic grains and megacrysts up to 1 cm long. They are twinned according to the albite and combined Carlsbad-albite twin laws and are of oligoclase composition. The plagioclase varies from fresh to extensively sericitized; calcite and rare epidote are locally present. The alteration in many instances is concentrated in the center of the crystal or in zonal bands. Rapakivi texture and rare zoning are developed and myrmekites are locally present. Brown biotite is fresh or variably altered to chlorite with anomalous purplish-blue interference colors. Muscovite is generally present as secondary sericite but rare large crystals intergrown with the biotite may be primary. Green pleochroic hornblende, variably altered to chlorite, is present in minor amounts in the granodioritic rocks.

The mode of two thin sections of subunit 13c is quartz (45%), K-feldspar (28%), plagioclase (15%), biotite (8%), muscovite (3%) and accessories (1%). Apatite, iron oxides and sphene and secondary sericite, chlorite and epidote are the principal accessory minerals. Quartz occurs as anhedral, interstitial grains with undulose extinction that range from <1 to 4 mm in size. Sutured and subgrain boundaries are developed. Microcline with graphic textures occur not only as anhedral to subhedral perthitic grains, from <1 to 4 mm long, but also as rare phenocrysts. Subhedral to euhedral oligoclase occurs as

crystals up to 2.5 mm in size. The oligoclase is moderately sericitized. Brown pleochroic biotite and muscovite occur as intergranular flakes. The muscovite occurs both in individual griesens and in association with biotite. The biotite is variably altered to chlorite which commonly has anomalous purple interference colors.

The biotite diorite and gabbro contain 10 to 15 per cent interstitial quartz with undulose extinction and a grain size generally <0.5 mm. The plagioclase occurs as subhedral to euhedral, twinned andesine crystals (An_{40}) ranging in size from 0.4 to 4.5 mm. It varies between being relatively fresh and being extensively altered to finely disseminated sericite, calcite and epidote. The secondary minerals are commonly concentrated in the core of the crystals. The calcite locally occurs as large grains up to 4 mm across. Brown pleochroic biotite occurs as flakes averaging 1 mm in length. The biotite is moderately altered to chlorite. Secondary muscovite flakes locally occur in association with the biotite. Hornblende occurs as colorless to green pleochroic, anhedral to euhedral commonly chloritized crystals less than 0.4 mm across. The hornblende is generally less common than biotite. Apatite and iron oxides are common accessories.

Structure and metamorphism

The Buck Lake Granite generally does not contain a penetrative fabric; however, locally a penetrative foliation, axial planar to minor folds, is defined by aligned feldspar megacrysts and biotite. Dikes of granite cutting metasedimentary rafts have been boudinaged and necked. A cataclastic fabric defined by aligned feldspar phenocrysts, biotite and quartz is developed in places, particularly east of Peter Strides Pond, east of Rocky Ridge Pond and south of Buck Lake where a major fault cuts the granite. Locally, these fabrics are traceable into protomylonite and mylonite. Protomylonites with classic cataclastic textures are developed south of Buck Lake. Textures include rolled grains (porphyroclasts), fractured porphyroclasts, fluxion lines, augen structure, mica (sericite, muscovite and biotite) trains and recrystallized quartzofeldspathic mortar and trails. Pseudotachylyte is locally present in the mylonite south of Buck Lake. Metamorphism in Unit 13 was under subgreenschist or lower greenschist facies conditions.

Contact relationships

Unit 13 is intrusive into Unit 8 subsequent to migmatitization and metamorphism; granite sheets of Unit 13 are folded and foliated with the paragneissic and migmatitic banding. It is also intrusive into Unit 12. Dikes of an undeformed K-feldspar porphyritic granite intrude Unit 10 subsequent to mylonitization; however, Unit 13 is itself cataclastically deformed south and east of Peter Strides Pond and near the contact with subunit 8a south of Buck Lake area. The regional migmatitization is considered to be Silurian in age (see section on structural and metamorphic history of the area), hence a Silurian or later age is implied for the granite. It is lithologically similar to Devonian granites that occur throughout central Newfoundland. The relationship to the Devonian Windsor Point Group is not known but is assumed to be an unconformity.

Gabbro and Diorite (Unit 14)

Definition, division and distribution

Unit 14 comprises an unnamed and unseparated complex of gabbro, diorite and their granitic differentiates which forms a northeast trending body between Boogie Lake and the northern boundary of the map sheet. It also includes a number of small bodies scattered throughout the map area. Many outcrops consist of a mixture of intrusive rocks and xenoliths of ophiolite affinity. Areas with common feldspar-phyric phases are designated as subunit 14a.

The unit is best exposed in the hills north of Boogie Lake and west of the Burgeo Road.

Lithology

The main body of Unit 14 consists of medium to coarse grained, dark gray to black, locally leucocratic, equigranular and undeformed gabbro and diorite. The gabbro consists of plagioclase and chloritized hornblende. Shearing and chlorite-coated fracture surfaces are common. Pegmatite, coarse mafic patches, and epidote knots and veins are well developed in places. The medium grained, gray equigranular diorite grades into the gabbro and also forms dikes cutting the gabbro. These rocks, in particular the diorites, are commonly characterized by distinctive pink plagioclase which can easily be mistaken for K-feldspar. In places the gabbro appears to grade into plagiophyric phases; however, younger plagiophyric gabbro and diabase dikes are intrusive into the gabbro. The mafic rocks are intruded by 2 cm to 1 m wide dikes, veins and irregular bodies of pink and white granite, red aplite, white and gray granodiorite and trondhjemite. This results in the development of intrusion breccias. Gray diabase and/or andesite dikes intrude the mafic rocks. Late, vesicular diabase dikes 0.25 to 3 m wide with well developed chilled and locally flow-banded margins cut the granitic phases. Shearing is extensive along fault zones.

Petrography

Mafic rocks of Unit 14 show a petrographic variation from gabbro to quartz diorite. The gabbroic rocks consist mainly of green-brown pleochroic hornblende plagioclase and minor pyroxene. Texturally the gabbros vary from subophitic and intergranular to hypidiomorphic-granular. Accessory minerals include primary sphene and extensive magnetite, and secondary actinolite-tremolite, chlorite, epidote, calcite, sericite, hornblende and quartz. Simple-twinned, green-brown hornblende forms anhedral to subhedral, intergranular grains up to 2 mm across. It is variably altered to chlorite. There are stumpy to tabular, euhedral crystals of calcic andesine and sodic labradorite. The plagioclase varies from 0.2 to 2 mm, locally up to 4.5 mm in length and from relatively fresh to extensively saussuritized. Quartz occurs as minor, anhedral, interstitial grains and is probably in part secondary. Locally the quartz reaches 10 per cent. Clinopyroxene is only locally present, and is moderately to extensively altered to green fibrous amphibole (actinolite and tremolite), chlorite and green, granular hornblende. Rare colorless to slightly pink orthopyroxene is locally present and is probably hypersthene.

The gabbro generally grades into, but is in places cut by, hypidiomorphic-granular diorite with abundant green hornblende and oligoclase-andesine plagioclase. Stumpy to tabular, generally euhedral, crystals of plagioclase average 0.6 mm long; locally they reach 1.7 mm. They are moderately to completely saussuritized with sericite and calcite being the most common secondary minerals. This alteration in many cases imparts a pinkish hue to the plagioclase. Albite and quartz are locally common as secondary minerals replacing the primary feldspar. In places, rims of fresh albite and locally K-feldspar mantle the altered plagioclase. Green pleochroic hornblende, with common simple twins, is variably altered to green chlorite. The hornblende forms anhedral to subhedral crystals up to 0.9 mm in size. Brown biotite is a minor constituent. It is altered to chlorite with anomalous purple interference colors. Quartz occurs as an anhedral interstitial mineral and varies from approximately 5 to 15 per cent; however, in places much of it could be secondary. The feldspar-phyric rocks consist of euhedral plagioclase microphenocrysts to phenocrysts extensively altered to carbonate, epidote and sericite and have

rims of albite in places. Green pleochroic amphibole (hornblende?), actinolite-tremolite and chlorite occur as intergranular minerals. Magnetite, sphene and apatite are the principal accessory minerals.

The diabase dikes consist of fine grained plagioclase crystals (generally about 0.1 mm); commonly they have feathery edges. The angular interstices between them are filled by fine grained to cryptocrystalline material, such as actinolite, chlorite, epidote, quartz and opaques. Microphenocrysts and phenocrysts of plagioclase are variably altered to epidote, clinozoisite, sericite and calcite. Magnetite and sphene occur as accessory minerals.

The felsic rocks in this unit contain from less than 1 per cent to approximately 5 per cent anhedral orthoclase. The quartz forms anhedral interstitial grains that range from 0.45 to 2.5 mm in size. It commonly possesses undulose extinction, and may constitute 25 to 30 per cent of the rock. Oligoclase, occurring as subhedral to euhedral rectangular and stumpy crystals, averaging 2.5 mm long, constitutes 30 to 60 per cent of the rock. It is zoned in places and locally is mantled by alkali feldspar and by albite. The plagioclases are either slightly sericitized or completely altered to sericite and minor calcite and epidote, particularly in the cores of crystals. Mafic minerals locally comprise up to 15 per cent of the rocks; they include green, simply twinned, pleochroic hornblende and brown biotite. Both are variably altered to chlorite. The chlorite after the biotite generally has anomalous purple interference colors. The granites contain common perthitic microcline and orthoclase, with biotite being the predominant mafic mineral.

Veinlets and veins of calcite, quartz, epidote and clinozoisite cut all the above rocks.

Contact relationships

Rocks of Unit 14 are intrusive into the Victoria Lake Group and the King George IV Lake complex, and contain large xenoliths of ophiolitic rocks, in particular north of Boogie Lake. Rare small clasts (<2 cm) of a fine grained red, possibly sedimentary rock similar to the redbeds of the Windsor Point Group were noted in an outcrop west of the Burgeo Road near the north end of the map area. However, there is no evidence of contact metamorphism in the Windsor Point Group even within 6 m of the contact. Gabbro clasts similar to this unit also occur in the Windsor Point Group. The Windsor Point Group is thus interpreted to overlie unconformably the unit. The relationship of Unit 14 to the Buck Lake Granite (Unit 13) is not known.

WINDSOR POINT GROUP (UNIT 15)

Definition, Division and Distribution

Brown (1975, 1977) proposed the name Windsor Point Group for a sequence of Carboniferous or older metasedimentary and metavolcanic rocks disposed along the Cape Ray Fault in the Cape Ray area of southwestern Newfoundland. The group is northeasterly trending and locally steeply dipping. In the type area the group consists of ignimbrite, tuff, conglomerate, shale and rhyolite. The group unconformably overlies the Long Range Gneiss of Brown (1975, 1977).

A belt of low grade mafic and felsic volcanic and sedimentary rocks deposited along the Cape Ray Fault northeast of the Cape Ray area was assigned to the Billards Brook formation (Chorlton, 1980b). These rocks were originally assigned to the Bay du Nord Group (Cooper, 1954) but are now removed from that group and are correlated with the Windsor Point Group (Chorlton, 1980b). Plant fossils indicate a Devonian age for the Billards Brook formation.

Unit 15

Definition, division and distribution

Unit 15 is a sequence of alluvial conglomerate, sandstone, siltstone and intercalated terrestrial to shallow water mafic and felsic volcanic rocks. It forms a 1 to 2.5 km wide, northeast trending belt across the western corner of the map area, continuous from its southwest corner to King George IV Lake. Small, isolated outcrops of similar lithologies occur along the east shore of King George IV Lake and extend to the northern boundary of the map area. A fault bound sliver of similar lithologies occurs within the Victoria Lake Group on the Burgeo Road. The unit was deposited along the trace of a splay of the Cape Ray Fault. It is generally northwest facing; however there is local overturning to the southeast.

The unit is divided into four main subdivisions; alluvial redbed sedimentary rocks (subunit 15a) and intercalated mafic (subunit 15b) and felsic (subunit 15c) volcanic rocks, and gray litharenite and interbedded conglomerate and siltstone (subunit 15d). Sedimentary rocks are predominant in the unit. Felsic volcanic rocks predominate over the mafic volcanic rocks; the felsic volcanics are particularly common in the north.

Excellent exposures of the unit occur in hills around Princess Lake, in places along the stream north and west of Princess Lake, in the quarry on the Burgeo Road at the north end of the map area.

Age and correlation

Plant fossils were collected from two areas along the stream west of Princess Lake, with the best locality approximately 1.0 km upstream from King George IV Lake. Two samples collected from this locality yield spores, identified by D.C. McGregor of the Geological Survey of Canada (Report Fl-8-1981-DCM) as indicating a late Early Devonian age. The palynology of these rock samples is as follows:

1. G.S.C. Locality 97913
   Field No. 80-NJ-79A

Remarks: Fragments of plant tissue, including parts of vascular plants, as well as trilete spores are abundant. The only taxonomically identifiable specimens are the spores *Emphanisporites rotatus* McGregor and *Retusotriletes* sp.

Assignment of a precise age based on this meagre evidence is impossible. Some more general conclusions can be drawn however. The sample is no older than about mid-Siegenian, based on the size and general form of the spores. A mid to late Emsian age is suggested, tentatively, because of some spores that may be the degraded remains of spinose camerates, and the presence of *Emphanisporites rotatus*, which is most abundant in the Emsian elsewhere and is rare in younger deposits.

2. G.S.C. Localilty 97914
   Field No. 80-NJ-79B

Remarks: *Retusotriletes* sp. is the only palynomorph identifiable.

Unit 15 resembles the Billards Brook formation of Chorlton (1980b) in lithology, stratigraphy, and age, and has a similar mode of occurrence. Chorlton (personal communications, 1981) has assigned the Billards Brook formation to the Windsor Point Group (Brown, 1975, 1977) and Unit 15 is herein assigned to that group also.

Lithology

Subunit 15a consists predominantly of alluvial, red sandstone and

siltstone, and minor conglomerate and limestone. The redbed sequence in the quarry along the Burgeo Road consists of red interbedded fine grained sandstone, siltstone, and minor granule to pebble sandstone.

The fine grained sandstone beds are generally 20 to 60 cm thick, internally laminated, current-lineated and are in places erosional into siltstone. They are graded and planar crossbedded and grade upward into laminated siltstone and mudstone (Plate 16). Black chips or flakes of mudstone are locally common and thin discontinuous lenses of conglomerate are locally present. Rare green beds of sandstone are also present and are interpreted to be a result of reduction.

The coarse grained sandstones occur as graded beds and lenses within or at the base of the sandstone units. They generally have sharp, erosional bases, are 1 to 15 cm thick, and have an average grain size <4 mm. The beds are generally stratified, grade into fine sandstone and are either massive or crossbedded. Fine sandstone lenses are present within these beds. The predominant clast type is red siltstone and mudstone rip-ups (intraclasts) ranging up to 0.5 cm wide and 15 cm long; well rounded quartz clasts are also common. Other clasts are red sandstone, red rhyolite, minor black mudstone flakes and minor gabbro (approximately 2.5 mm across) and rare pebbles of granite. The coarse sandstone is subordinate to the overlying red sandstone. Poorly sorted, crudely fine grained, graded pebble to cobble conglomerate with crossbedding and imbrication indicating transport to the northeast, is present immediately north of the map area.

The siltstones occur as thin (6 mm to 5 cm) beds at the top of the sandstone. Sedimentary features, such as ripple-marks, mud curls, mud flake layers and polygonal dessication cracks are commonly developed in the siltstone-mudstone layers. Locally, beds up to 1 m thick of laminated, red, cherty (or siliceous) siltstone-mudstone with convolute laminations (dixatropic deformation) are developed. Cross-faults with displacements of a few centimetres are common.

Beds and lenses of red sandstone, rare siltstone, conglomerate, rare breccia and 2 m thick, aphanitic, gray unfossiliferous arenitic limestone lenses occur along the east shore of King George IV Lake. Felsic volcanic clasts and lesser amounts of granite, red sandstone and quartz constitute the pebble orthoconglomerate beds in this sequence. Minor mafic flows are also intercalated in the sequence. East of Princess Lake, intercalated mafic volcanics, red to purple cobble conglomerate, laminated red siltstone and minor crossbedded red sandstone constitute the redbed sequence. The clasts are mainly porphyry, flow-banded rhyolite and red chert.

On the southeast side of the stream that lies west of Princess Lake, the redbeds consist of interbedded pebble conglomerate up to 1 m thick, crossbedded, coarse grained sandstone, graded or crossbedded, medium grained sandstone, and minor siltstone. Pebble imbrication indicates northeastward pebble transport. There appears to be a gradation from the redbed sequence to the green-gray sequence of subunit 14d in this area.

A fault-bounded sliver of fine grained, red sandstone and siltstone with minor felsic volcanic breccia and mafic flows occurs along the Burgeo Road within the Victoria Lake Group.

Intercalated epiclastic breccias contain poorly sorted clasts up to boulder size of felsic volcanic, gabbro and sedimentary rocks (locally soft-sediment deformed) in a matrix that varies from vitric to fine grained clastic. Locally the matrix consists of flow-aligned and soft-sediment deformed sand and mud. Pumice and flattening or welding structures are present in the breccias along the east shore of King George IV Lake (Plate 17).

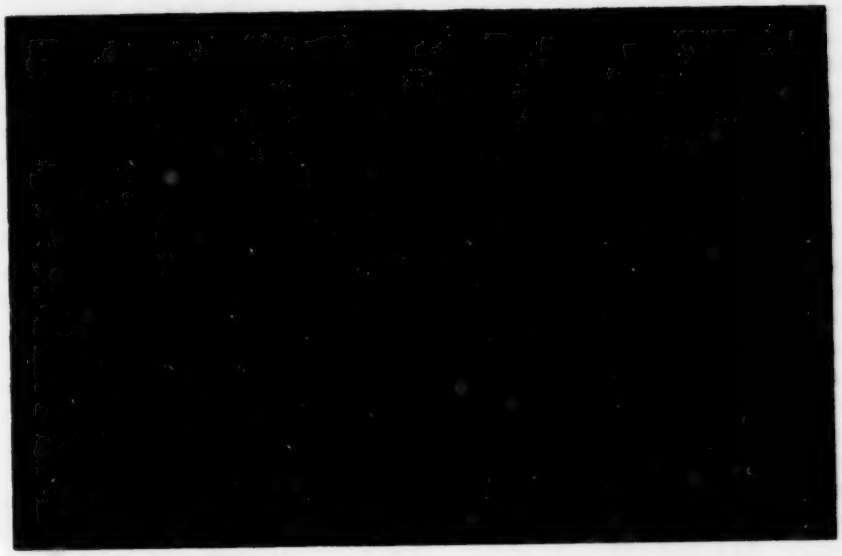


Plate 16: Crossbedded sandstone, Windsor Point Group, quarry on Burgeo Road at north end of map sheet.

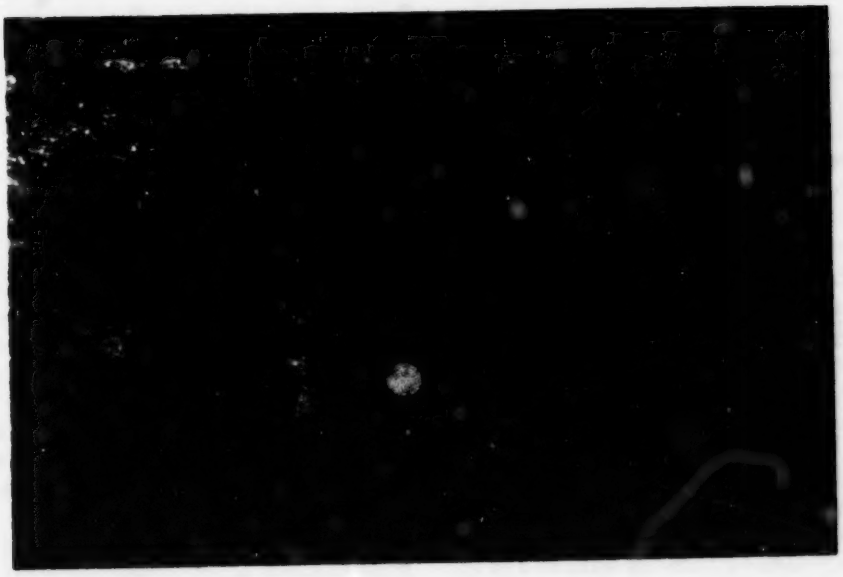


Plate 17: Laharic flow, Windsor Point Group, east side of King George IV Lake.

Intercalated mafic and felsic volcanic rocks are locally common in the redbed sequence and indicate contemporaneous volcanism.

Subunit 15b consists of mafic volcanic rocks intercalated with the redbeds. Maroon plagiophyric, vesicular and calcite-rich amygdaloidal mafic flows are intercalated with the sedimentary sequence along the east side of King George IV Lake. Green to gray, cleaved mafic volcanics and local pyritized chlorite ± actinolite schists occur in the extreme southwest part of the unit. Green to maroon, calcite-rich amygdaloidal mafic flows with incipient to poorly developed pillow structures are intercalated with crossbedded red sandstone west of the north end of Princess Lake. Individual pillow structures reach up to 20 cm in maximum diameter and red and/or green chert is present as interpillow material.

Subunit 15c consists of felsic volcanic rocks. The subunit occurs mainly intercalated with the redbeds of subunit 15a. Pink, red and brown rhyolite breccia and lapilli tuff, flow-banded tuff and lapilli tuff and welded rhyolitic tuff are the most common rock types. Black lapilli tuff with a vitric matrix is present in the hills west of the quarry. Green to gray lapilli tuff and breccia are common in places, particularly along the shore of the ponds to the east of the redbed quarry.

The reddish breccia consists of poorly sorted or unsorted, angular to rounded and elongate clasts in a red, locally green, fine grained to aphanitic matrix. Rhyolite, welded tuff, coarse grained green gabbro and minor diabase (2 to 25 cm) and, locally, red sandstone and siltstone are the predominant clasts. The rhyolitic clasts are red to pink, structureless, flow-banded and locally feldspar-phyric. The clasts are in places up to 0.5 m across. The breccia is generally unsorted but a crude fining upward stratification is locally developed. In the redbed quarry the breccia flows or lahars overlie, with fault contact, dense, conchoidally fractured, reddish brown, eutaxitic banded, welded rhyolite tuff. Similar breccia also occurs in isolated outcrops structurally below the rhyolite. Small, angular and flattened red rhyolite clasts and fiamme are common in the welded rhyolite tuff. The rhyolite is vesiculated around inclusions of the redbeds; one inclusion of sandstone-siltstone measures 0.25 m by 2 m. Calcite is present as vug and fracture fillings. Manganese epidote (piemontite) occurs as pink coating on joint surfaces. The breccia is in fault contact with the overlying redbed sequence.

Red and pink, flow banded, generally plagiophyric rhyolitic tuff and lapilli tuff occur mainly east of the Burgeo Road. A banding defined by flattened shards and pumice is generally developed. Angular to subrounded clasts (2 to 25 mm) of red-brown rhyolite, feldspar-phyric red rhyolite, and red sandstone are common in these rocks.

Bedded green and gray tuff, lapilli tuff and breccia, exposed along the shores of a series of lakes on the north boundary of the map area east of the Burgeo Road, are typically interbedded and gradational. The fine grained tuff consists of green silicic tuff or a felsite resembling chert, bedded on a scale of 2 to 10 cm. The coarse tuff and breccia are up to 0.5 m thick with fine grained interbeds 5 to 15 cm thick. They contain subangular to rounded clasts of red and pink rhyolite, green felsite, basalt, red sediments, quartz, feldspar and pumice in a green, locally purplish aphanitic to vitric felsic matrix. The clasts vary from <0.5 to 3 cm in size.

Subunit 15d consists of orthoconglomerates interbedded with a gray, feldspathic litharenitic, lithic arkose and black siltstone-mudstone sequence. The sequence is exposed in the brook west of Princess Lake, in the vicinity of King George IV Lake, north and west of Princess Lake and around Lunde Pond.

In the brook south of King George IV Lake, interbedded gray feldspathic litharenite, varying in grain size from sandstone to granule sandstone, and black siltstone-mudstone beds are exposed (Plate 18). The sandstone forms layers up to 3 m thick with individual beds as thin as 10 cm, and the siltstone is generally <1 m thick in the lower part of the river section. In the upper parts of the section the sandstone beds are 0.5 to 1 m thick and the siltstone beds are about 1 m thick. The sandstone is generally graded and trough crossbedded, and has covered bases. There are local lenses 10 cm thick and 1 m long, of clast-supported pebble conglomerate with scour and fill structures. Black mudstone and siltstone, and felsic volcanics are common lithic clasts in these rocks. Locally, such as near the narrows on the northeast arm of King George IV Lake, matrix-supported graded conglomerate with up to 65 per cent felsic volcanic clast content is the dominant rock type. The interbedded black mudstone, siltstone and argillite vary in thickness from 15 cm to 1.5 m and commonly contain plant fossils. Locally a gradation from medium grained sandstone, through laminated and rippled, dark gray sand and silt to mudstone is developed. Flat-topped sandstone lenses, with scoured bases are up to 15 cm thick and several metres long.

Gray to minor red or purple, granule to boulder conglomerate locally predominates, particularly north and west of Princess Lake. The conglomerate is locally interbedded, laminated or trough crossbedded sandstone. Clast shape varies from subangular to well rounded, and is commonly highly spherical. Clasts range from a few millimetres to 30 cm in size, although they are locally up to 65 cm. Their long axis is generally oriented parallel to bedding (Plate 19). The conglomerate is generally clast-supported with sand occurring as interclast material. Locally, however the clasts are supported by a quartzofeldspathic sandstone matrix. The conglomerate is moderately to poorly sorted, although grading is commonly developed. The detrital assemblages include quartz-feldspar porphyritic volcanics, black, purple and red, massive and flow-banded rhyolite, mafic volcanics, felsite, green and red chert, rare pumice, red sandstone and siltstone, black argillite and siltstone, rare paragneiss with folded banding, massive and foliated granite, gabbro, diabase, minor vein quartz and a reddish brown weathering rock that could be ultramafic. The gabbro and diabase clasts are more common near the Annieopsquotch Mountains complex.

In the stream west of Princess Lake, altered and weathered, pink K-feldspar granite of the Lloyds River Intrusive Suite (Unit 11) is overlain by gray sandstone, granule to cobble conglomerate and interbedded black siltstone/mudstone. The sandstone and conglomerate contain granite and pink K-feldspar clasts. Other clasts include mafic and felsic volcanic and sedimentary rocks.

Diabase dikes, up to 1 m thick and in places feldspar-phyric, intrude all units of the group.

Petrography

In the redbed sequence, the granule sandstone beds consist of poorly to moderately sorted, subangular to rounded clasts in a well sorted sandstone matrix. Volcanic quartz, up to 2 mm, is abundant, and in places has preserved hexagonal crystal faces. *In situ* brecciation of the quartz is locally developed. Moderately to extensively altered alkali feldspar is locally prevalent and graphic feldspar is locally common. Lithic clasts, with a grain size up to 3 mm, consist of red rhyolite, felsite (locally spherulitic), basalt, diabase and rare gabbro (in places chloritized and epidotized), hematite-rich siltstone, sandstone and rare conglomerate, and hematized volcanics and minor graphitic (?) shale.

Plate 18: Interbedded gray sandstone and fossiliferous black siltstone, Windsor Point Group, approximately 1 km upstream from King George IV Lake on Princess Lake Brook. Top is toward left.

Plate 19: Cobble to boulder orthoconglomerate of the Windsor Point Group, northwest of Princess Lake.

Well rounded grains of epidote are common. Calcite and hematite form cement in a fine grained, generally 0.07 mm, well sorted matrix of quartz, minor muscovite and lithic clasts.

The redbed sandstone consists of subrounded to rounded, moderately to well sorted clasts with an average grain size of 0.4 mm. The proportions of clast types are highly variable, but quartz generally predominates and in places constitutes up to 80 per cent of the detrital assemblage. Feldspar varies from 10 to 30 per cent of the total clast content; the lithic clast content varies from 5 to 20 per cent. The ratio of clasts to matrix varies from 90/10 to 30/70. Plagioclase is the predominant feldspar; K-feldspar and graphic feldspar are less common. Lithic clasts include felsite, rhyolite, basalt, red sandstone and siltstone, and minor highly epidotized clasts. Minor muscovite flakes and rounded epidote grains are also present. Extensive carbonate and hematite is present in the matrix as a cement.

The red siltstone is composed of well sorted, subrounded to rounded silt-size (about 0.05 mm) quartz, feldspar, lithic and rare epidote clasts, and minor muscovite flakes. A cement of hematite or hematized silt and minor calcite occurs between the clasts; calcite veins are locally common. Diagenetic pyrite is present in all of these rocks.

The mafic volcanic rocks of subunit 15b contain feldspar phenocrysts or microphenocrysts that range up to 5 mm in size. The feldspars vary from moderately to completely saussuritized. Calcite is a commonly developed alteration mineral and it also occurs extensively in fractures, vugs and vesicles. Stumpy feldspar crystals and randomly to subradially oriented, saussuritized plagioclase microlites with intergranular hematite, calcite chlorite, epidote and rare sphene constitute the matrix. In places, altered ophitic clinopyroxene is present. Chlorite is common as amygdules.

The red-brown, conchoidal fracturing welded rhyolitic tuff of subunit 15c consists of strongly hematized, red or brown, weakly banded felsite (devitrified glass?) with lighter colored zones of recrystallized pumice (Plate 20). The pumice has recrystallized to a felsitic intergrowth of quartz, feldspar and minor sericite and is moderately aligned and elongated to give a discontinuous and crude banding. It constitutes approximately 20 to 25 per cent of the rock; individual pumice fragments reach up to 1.5 mm. The remainder of the rock consists of a dense, hematite-rich felsite with a faint, flow-folded banding defined by flattened shards. Iron oxide and pyrite occur as accessory minerals.

The strongly flow-banded, plagiophyric rhyolite or rhyodacite, tuff and lapilli tuff occurring east of the Burgeo Road consist mainly of a dense aggregate of seriate feldspar crystals, up to 2 mm long. The feldspar is predominantly subhedral to euhedral oligoclase; Carlsbad-twinned, sericitized sanidine crystals and fragments are less common. Minor volcanic quartz displays both well preserved hexagonal outlines and deeply embayed textures. Lithic clasts are rare; these include hematized rhyolitic tuff and feldspar-phyric rhyolitic tuff. The matrix of the rhyolite tuff is generally a dense intergrowth of quartz and feldspar with minor sericite, and is rich in hematite. Flattened and recrystallized pumice and shards are recognizable in places and along with small feldspar crystals define a eutaxitic banding.

The coarse grained breccia in the redbed quarry contains rhyolite clasts that are mineralogically and texturally similar to the rhyolitic tuff. The matrix of the breccia varies from aphanitic to consisting of fine grained lithic clasts with calcite cement.

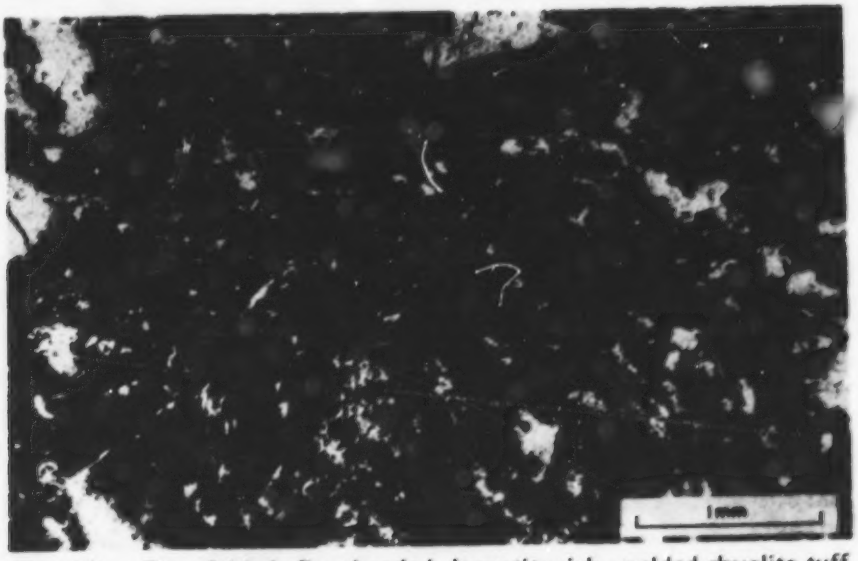


Plate 20: Flow-folded, flow-banded, hematite-rich, welded rhyolite tuff, Windsor Point Group, Burgeo Road. Light areas are recrystallized (felsite) glass and pumice.

The black lapilli tuff and breccia outcropping west of the Burgeo Road consists of angular and unsorted clasts from 0.1 to 75 mm long in a cryptocrystalline felsite or devitrified siliceous glass that is peppered with iron oxide and occasional pyrite. Chlorite, calcite and rare sericite are disseminated throughout the matrix. Chlorite also locally occurs as large aggregates. The most common clasts are subhedral and rare euhedral oligoclase and sanidine crystals and crystal fragments. Quartz crystal fragments are a rare constituent. Clinopyroxene is common as small crystals and crystal fragments. Lithic clasts are mainly felsite and basalt.

The bedded, green lapilli tuff and breccia consist of poorly to moderately sorted, angular to subrounded clasts in an aphanitic to cryptocrystalline felsitic matrix. These clasts include pink and red rhyolite, ignimbrite/welded tuff, feldspar porphyry, scoriaceous, variolitic and feldspar-phyric basalt, extensive quartz, plagioclase and sanidine crystals, hematized sediments and volcanics, unflattened granophyric pumice lapilli, extensively chloritized ruled pumice lapilli with wispy ends (Plate 21), and rare shards. The pumice in places contains plagioclase phenocrysts and locally quartz. Chloritization of the mafic volcanic clasts is common, and calcite is disseminated throughout the matrix and as an alteration of feldspar. The crystal clasts vary from 0.07 to 1.8 mm in size, the lithic clasts from 0.8 to 3 cm. Variable amounts of iron oxide and pyrite are present in the matrix. The fine grained tuff consists of well sorted, silt- to fine sand-size clasts of quartz and feldspar in a sericitic felsite matrix.

The lithic arkose and feldspathic litharenite of subunit 15d are moderately sorted, generally clast-supported and range in grain size from 0.2 to 10 mm, locally up to 2 cm. Quartz is generally the most common constituent in these rocks. Feldspar is the next most common detrital constituent. However, locally the proportions of quartz, feldspar, and lithic clasts are about equal. Clear, volcanic quartz is very common; plutonic quartz and quartz with spectacular graphic textures (Plate 22) are also very common. Both andesine

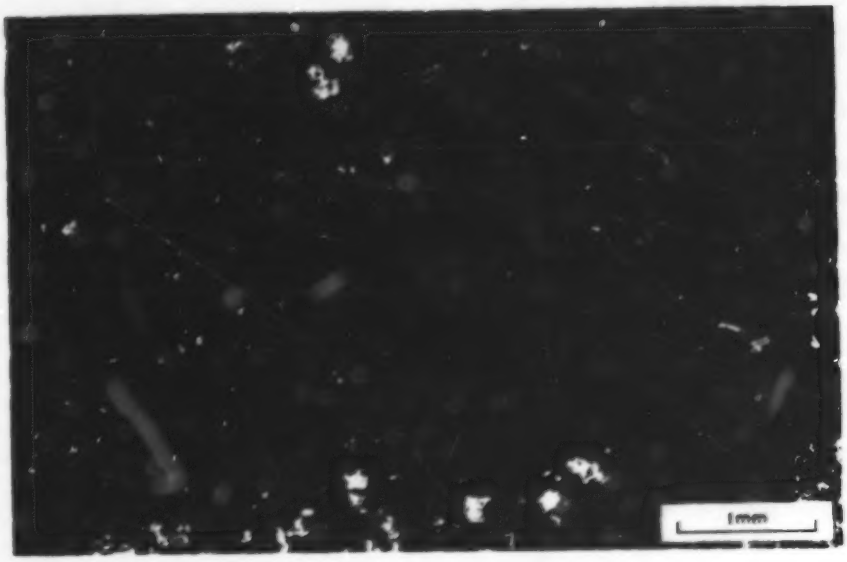


Plate 21: Ruled pumice lapilli in crystal-lithic lapilli tuff of the Windsor Point Group, ponds east of Burgeo Road.

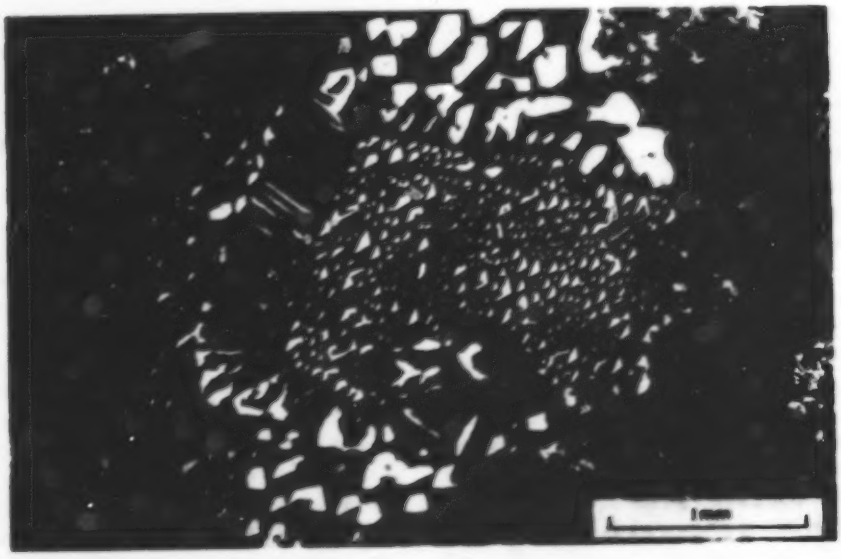


Plate 22: Clast of quartz (light) intergrown with alkali feldspar in sandstone of Windsor Point Group, same locality as Plate 18.

and potassium feldspar are present but slightly to moderately sericitized andesine predominates. Detrital biotite, chloritized biotite, rare epidote and sphene grains are also present. The lithic clasts include basalt, massive rhyolite, flow-banded rhyolite, welded tuff, felsite, rare spherulitic felsite and rhyolite, feldspar porphyry, rare chert, rare pumice and rare granite. A common clast is clay- and graphite-rich shale or mudstone. The clasts are angular to subrounded. The matrix constitutes a minor proportion of the rocks, and occurs as sericite, carbonate (calcite) and fine grained rock fragments filling the angular interstices between grains.

Sandstone associated with the coarse conglomerates in subunit 15d contains poorly sorted, angular to subrounded clasts with a grain size from 0.1 to 2.5 mm. Volcanic quartz is the most common constituent with lithic clasts being the next most common. They include basalt, felsite (rhyolite), sericitic felsite, hematized sedimentary and volcanic rocks, green chert and rare sericite schist. Andesine is also a common constituent; epidote, rare muscovite and a chlorite- and iron-oxide-rich clast with wispy ends are minor constituents. The matrix is fine grained with common sericite and calcite. Chlorite is also common and masks some of the clasts.

Structure and metamorphism

The Windsor Point Group is restricted to a narrow, linear zone that is defined by a splay of the Cape Ray Fault. The group trends northeasterly, generally dips northwest and is locally overturned particularly in the quarry on the Burgeo Road and along the unconformable contact with Unit 11. It has been openly to moderately openly folded around northeast trending fold axes. No regional penetrative axial planar fabric is developed; however, in the contact areas the rocks are locally highly cleaved. This is presumably related to late faulting and shearing. Minor faulting is generally common, and small cross-faults perpendicular to bedding can easily be seen in the quarry at the north end of the map area.

The sequence has been metamorphosed under subgreenschist to lower greenschist facies conditions.

Contact relationships

Unit 15 is in fault contact to the east with Unit 8 and with the King George IV Lake complex. However, based on the presence of detritus lithologically similar to these units in Unit 15, an original unconformable relationship is inferred. An unconformable contact with the Lloyds River Intrusive Suite (Unit 11) is exposed along the stream west of Princess Lake. Here, conglomerate and sandstone of Unit 15 contain clasts of the intrusive suite.

Granite (Unit 16)

Definition, division and distribution

Three pink to red granite bodies are assigned to Unit 16. A muscovite-garnet-biotite granite occurring as a small, elongate body on the west side of Rocky Ridge Pond is assigned to subunit 16a. Subunit 16b is a biotite, locally pyroxene, granite occurring in the northwest corner of the map area. subunit 16c is a coarse grained, biotite granite occupying a central area along the western margins of the map area.

Lithology

Subunit 16a is a pink to red, medium grained, equigranular granite. Muscovite, garnet and biotite are the diagnostic minerals. The garnets are euhedral and less than 2 mm across; the muscovite content is greater than biotite. It varies from undeformed to having a weak foliation defined by quartz.

Subunit 16b is also a pink and red, medium grained, massive to weakly foliated, equigranular granite. Biotite is the main mafic component, although locally, in coarse zones, clinopyroxene is present. Green amphibole occurs within the pyroxene and also as rims around it. Muscovite was not noted. The foliation is defined by biotite and is locally openly folded. Xenoliths of migmatite are common.

Subunit 16c is a pinkish, medium to coarse grained biotite granite. It is generally equigranular, but locally contains K-feldspar megacrysts up to 1 cm. There is generally no measurable tectonic fabric; however, in places there is a weak biotite alignment. Xenoliths of the country rocks are common.

Petrography

The mode of two thin sections of subunit 16a is K-feldspar (41%), quartz (40%), plagioclase (14%), muscovite (3%), biotite (<1%), garnet (<1%), and accessories (<1%). The accessory minerals are principally apatite and opaques (iron oxide) and minor secondary sericite, chlorite and rare epidote. The texture is hypidiomorphic granular. The K-feldspar occurs as anhedral, intergranular grains and as subhedral to euhedral perthite crystals from <1 to >4 mm across. Quadrille twinning is commonly developed in the microcline; in places, however, K-feldspar with simple twins consisting of two individuals (orthoclase?) is prevalent and locally constitutes up to 40% of the K-feldspar. The K-feldspar contains inclusions of quartz and minor plagioclase; graphic textures are common on the margins of the crystals. Quartz occurs as anhedral, interstitial grains with undulose extinction, subgrain boundaries and minor fracturing. The grain size of the quartz is 3 to 5 mm but locally is up to 7 mm. Oligoclase occurs as blocky, turbid, euhedral crystals, about 1 mm across, with minor sericite alteration. Mantles of alkali feldspar on the plagioclase are well developed in places. Muscovite flakes and fibers, up to 1.5 mm long, occur individually and in association with biotite. Anhedral biotite is pleochoic from yellow-brown to green-brown and is variably altered to chlorite, which in places has anomalous purple interference colors. The margins of the biotite are locally altered to muscovite. Garnets occur as euhedral grains which are in places partly replaced.

Subunit 16b consists of quartz, plagioclase, microcline, orthoclase, biotite, and locally clinopyroxene and amphibole. The quartz occurs as anhedral, interstitial grains. Oligoclase is relatively fresh, with minor incipient sericitization, and forms blocky to prismatic, subhedral to euhedral crystals. Bent twin lamellae are common, and in places the oligoclase is rimmed by K-feldspar. Anhedral to subhedral, perthitic K-feldspar is predominantly microcline. Perthites with spectacular exsolved albite-twinned albite are well developed (Plate 23). Plagioclase is a common inclusion in the K-feldspar. Biotite flakes are variably altered to chlorite. In rare samples, euhedral clinopyroxene (augite?) crystals up to 7 mm in size are present. The clinopyroxene is characterized by an orange-brown to red (hematite?) staining or exsolution that commonly forms a dendritic pattern along the cleavage planes and partings. The pyroxene is pleochroic from pale to deep green. Olivine or brown-green to dark green pleochroic amphibole mantles and occurs within the pyroxene.

Subunit 16c consists of K-feldspar (41%), quartz (35%), plagioclase (15%), biotite (8%), and accessories (1%). The accessory minerals include primary iron oxides, zircon and apatite, and minor secondary sericite, calcite and rare epidote. The K-feldspar is predominantly quadrille-twinned microcline but minor simple-twinned orthoclase is also present. They occur both as anhedral grains and/or subhedral or euhedral

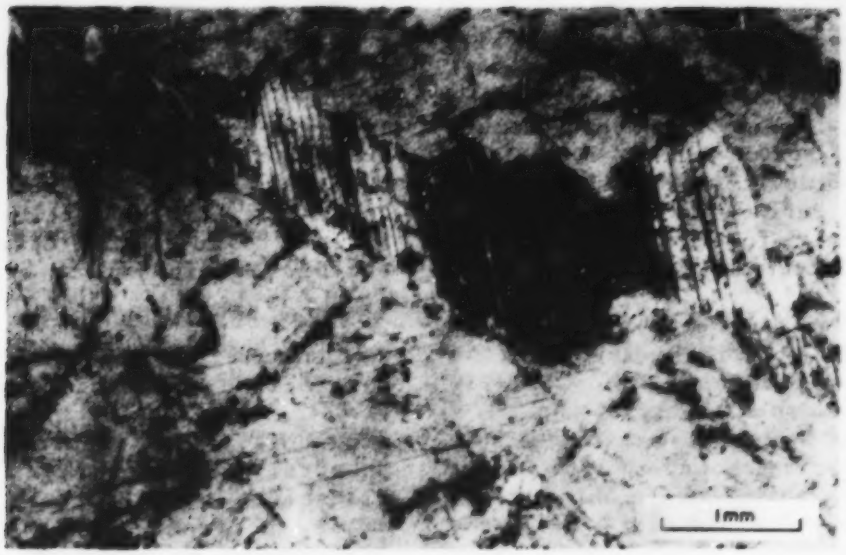


Plate 23: Albite-perthitic microcline, Unit 16b.

prismatic crystals up to 1 cm long. They are strongly perthitic, commonly graphic textured and locally partly mantled by plagioclase. The quartz forms anhedral interstitial grains between 2.5 and 8 mm in size. It commonly possesses undulose extinction and embayed (sutured) boundaries. Small (generally <1.5 mm), subhedral blocky plagioclase crystals of oligoclase composition are generally fresh, but locally extensively sericitized plagioclase occurs as intergranular grains. Myrmekitic textures are generally developed. Brown pleochroic biotite is generally fresh, with only minor alteration to chlorite in places. The biotite generally occurs as small grains, <0.4 mm, intergranular to the felsic minerals.

Contact relationships

Unit 16 is intrusive into Unit 8 and 11 post-tectonically; it commonly contains xenoliths of these units. No contact metamorphism directly attributable to these granites has been noted.

Biotite Gabbro-norite (Unit 17)

Definition and distribution

A small body of biotite gabbro-norite outcrops along the west shore of Rocky Ridge Pond and on a number of small islands in it. A magnetic high outlined by airborne magnetic surveys (Geological Survey of Canada, 1968) suggests that the body underlies a large part of the lake.

Lithology

The body consists of dark, medium to coarse grained, equigranular gabbro-norite. It is characterized by the presence of biotite and a 'knobby' weathering pattern. It is undeformed and contains no tectonic fabric.

Petrography

The gabbro-norite consists of approximately 60 per cent plagioclase and 25 to 40 per cent intergranular mafic minerals. Quartz and accessories

are both less than one per cent. The accessory minerals are opaques (magnetite) or rare secondary chlorite after biotite. Quartz with undulose extinction is present as a minor intergranular anhedral mineral. The plagioclase (An_{40-44}) occurs as blocky to tabular, euhedral to subhedral crystals <0.2 to 3 mm in length. They are generally very fresh with the exception of rare incipient alteration along minor fractures; they commonly contain inclusions of pyroxene. Orthopyroxene and clinopyroxene are the most common mafic minerals. Hornblende and biotite form lesser constituents. Orthopyroxene is colorless, gray and locally reddish, nonpleochroic to slightly pale reddish pleochroic, probably hypersthene. It forms subhedral to euhedral crystals 0.8 to 2 mm in length. Clinopyroxene occurs as colorless to pale green augite crystals with moderate birefringence, about 0.6 mm across; simple twins and twin seams are locally developed. Hornblende occurs as subhedral crystals and is pleochoic from light to dark brown. It normally contains inclusions of pyroxene and plagioclase and is generally molded on or around the pyroxene. The hornblende has a grain size of about 1.5 mm. Subhedral to euhedral biotite crystals, up to 1.2 mm long, are pleochroic from light to reddish brown. The biotite occurs both as individual flakes and also in mineral aggregates with hornblende and locally pyroxene.

Contact relationships

Unit 17 is intrusive into migmatite of Unit 8, post-tectonically. There is no observed contact metamorphism in the country rocks. Similar lithologies occur to the northeast in the Victoria Lake map area (Kean, 1977), where a Jurassic (?) age was suggested for these rocks.

STRUCTURE

The structural history of the King George IV Lake area falls naturally into two parts. The first involves the polyphase deformation of the Cormacks Lake complex to produce a predominant northwest structural trend. The second involves the development of typical northeasterly Appalachian trends that vary from complex polydeformed structures to a simple single phase of deformation. Three or possibly four separate phases of deformation are mappable, although locally (for example, in the paragneiss and migmatite terrain) the structural history is more complex. Late, more localized events can also be recognized. The detailed structural history for each unit was given in the previous section.

Pre-Ordovician (?) Structures

No macroscopic structure has been worked out in the Cormacks Lake complex in the present map area. Type 1 and type 3 interference fold patterns (Ramsay, 1967) are common and Herd and Dunning (1979) recognized at least three phases of folding in the complex in the Puddle Pond map area to the north. There, *"early isoclines in paragneiss, are folded about relatively open folds which plunge consistently southeast. Another phase of folding is represented by open folds and crenulations in granite and paragneiss, which plunge variably southwest and northeast and consistently have a northeasterly axial trend. Left-lateral offset faults parallel this trend."* (op. cit. Herd and Dunning, 1979). They considered the northeast trends to predate the northwest trends but postdate the isoclines. A similar complex structural history is evident from the King George IV Lake area where a predominant northwest trend defined by a gneissic banding is folded around northeast trending structures. Early isoclines are preserved within the gneissic banding. Late north to northwest trending folds are locally present.

Based mainly on the regional northwest structural trend, these rocks are tentatively interpreted to have been originally deformed by the Grenville orogeny. They have been subsequently remobilized, overprinted by Appalachian

structures, and intruded by younger rocks. In the King George IV Lake map area they are intruded by the rocks of Unit 11 and in fact may regionally map out as a large roof pendant or xenoliths within Unit 11.

Acadian Structures

In Units 2 to 16 the northeasterly trend characteristic of the Appalachian structural province is the main structural style. Polyphase deformation is best developed in the Bay du Nord Group but is also seen in the Victoria Lake Group. In the Bay du Nord Group, the earliest discernible deformational event or events resulted in the production of the composite metamorphic layering or mineral segregation and a coplanar micaceous foliation. This layering probably is an amplification of pre-existing primary structures. In areas south of the King George IV Lake map area, tight, possibly recumbent, folding and the initiation of major slide zones accompanied this deformation (Chorlton, 1980b). Metamorphism was probably to the greenschist facies (?), and may have increased to lower amphibolite facies during the late stages of or following the deformation. Extensive mylonitization of Unit 10 granite occurred after the migmatization of the Bay du Nord Group but prior to major granite emplacement, and thus predates the main regional foliation.

These early structures were overprinted by a main, regionally mappable foliation associated with tight to isoclinal northeast, locally southwest plunging folds. The micaceous schistosity in the psammitic to pelitic rocks of the Bay du Nord Group and the inhomogeneously developed cleavage and schistosity in the volcanic rocks of the Victoria Lake Group are attributable to this event. The foliation in the Victoria Lake Group is defined by sericite and chlorite in areas of low grade metamorphism and by biotite, muscovite and hornblende in the higher grade rocks. The linear fabrics imparted by stretched fragments in the conglomerate of Unit 9 are also attributed to this deformation; however, the intensity of the fabric has been enhanced by later faulting. Granite sheets cutting the layered rocks are folded with the host by this deformation. Major fault or shear zones were reactivated and/or developed during this event. Protomylonites in granites of Unit 13 formed during this deformational event or subsequently.

The deposition of the Windsor Point Group records a major stratigraphic and structural break with the previously described evolution of the area. It marks an Acadian unconformity. Subsequent tectonic events resulted in open to moderately tight folding and tilting around northeast trending axes; however, there is no associated axial planar penetrative fabric. Internal faulting and shearing along the contacts may also be related to this deformation. The effects of the deformation outside of the fault zone along which the Windsor Point Group was deposited are difficult to recognize. They may be restricted to movements along pre-existing faults and shear zones.

A set of north to northwest trending open folds, kink bands, minor shear zones and late ptygmatic folding is the latest deformational event.

Faulting was significant in the tectonic development of the area. Two major faults are present in the map area, and they merge to the south in the La Poile River map area (110/16) to form the Cape Ray Fault (Chorlton, 1980b). The northern splay trends approximately forty-five degrees (45°) northeast and affects mostly rocks of the Bay du Nord Group, a granite (Unit 10) emplaced into it, and Unit 9 conglomerate. The Windsor Point Group was deposited along the northern margins of this fault zone. The fault is considered to have both dip-slip and strike-slip movement and to have been initiated during the earliest stages of deformation (Chorlton, 1980b)

as it predates, in part, the emplacement of Unit 13 granites. However, unlike the Cape Ray Fault to the south, movements subsequent to the deposition of the Windsor Point Group are minor, being generally restricted to contacts. The southern splay trends sixty degrees (60°) northeast across the extreme northeast corner of the map area. Cataclasites are developed in the megacrystic granites of Unit 13 in this fault zone. Minor shear zones, faults and cataclasites are developed throughout the map area.

METAMORPHISM

Paragneisses of the Cormacks Lake complex in the Puddle Pond map area are characterized by metamorphic assemblages of cordierite, garnet, and sillimanite (Herd and Dunning, 1979). This suggests that metamorphism was in middle to upper amphibolite facies conditions. The complex in the present map area has been retrogressed and is generally characterized by hornblende, biotite, epidote, calcite and by a granoblastic hornfels texture as a result of contact metamorhpism.

Herd and Dunning (1979) reported the presence of 'gedrite garbenschiefer' confined to (S_0/S_1?) layering in paragneiss of the Cormacks Lake complex, and suggested that it indicated metamorphism began early in the fold history.

The Bay du Nord and Victoria Lake Groups and the King George IV Lake complex are interpreted to be deformed and metamorphosed synchronously; thus they are considered to represent parts of the same metamorphic facies series reflecting different tectonic levels which are now juxtaposed by faulting. Elsewhere in central Newfoundland a progressive increase in metamorphic grade without a major structural break is demonstrable (Kean and Jayasinghe, 1980). The general regional lack of andalusite, cordierite and staurolite, except in contact aureoles, and only local occurrence of sillimanite suggest that the metamorphism is of the medium pressure type (Myashiro, 1973) modified by granite emplacement.

Metamorphism began during and peaked after the first deformation. The development of migmatite (mobilizate) in the Bay du Nord Group occurred during the metamorphic peak. Migmatization may be the result of either partial melting, or *in situ* metamorphic segregation and/or emplacement of granite derived from partial melts formed at deeper levels. Porphyroblasts overgrew the compositional (metamorphic) banding and early foliation and formed augen in subsequent deformations. The porphyroblastic growth is spatially related to granite intrusions.

The Bay du Nord Group generally contains the assemblage quartz, plagioclase, biotite, muscovite and rare sillimanite in the psammitic to pelitic compositions, and green hornblende, feldspar and quartz in the amphibolites. Anthophyllite is common in the calc-silicate bands. Staurolite, garnet, andalusite and cordierite overgrew the main fabric and generally occur near granite intrusions.

Most rocks of the Victoria Lake Group and King George IV Lake complex were metamorphosed to the greenschist facies. Mafic and intermediate compositions are characterized by chlorite, biotite, epidote, clinozoisite, calcite, albite and quartz. Sericite, muscovite, quartz and albite characterize the felsic and psammitic compositions. Green hornblende and late euhedral garnets, related to intrusions, are locally present indicating the metamorphic grade was locally in the amphibolite or upper greenschist facies.

The Windsor Point Group was deposited following the peak metamorphism of the other rocks and was metamorphosed to subgreenschist or lower greenschist facies during the third deformational event.

TIMING OF EVENTS

The upper Lower Devonian Windsor Point Group is interpreted to overlie unconformably the Bay du Nord Group (this report; Chorlton, 1980b). Thus the peak metamorphism and deformation that resulted in production of the migmatites, the major period of granite emplacement and the regional development of foliation is pre-late Early Devonian in age. Elsewhere in the Dunnage Zone of the Central Mobile Belt, this regional metamorphism affects rocks of Middle Ordovician to Silurian age (Williams, 1970; Kean and Jayasinghe, 1980) and was interpreted to be related to emplacement of granites during the Acadian orogeny (Kean and Jayasinghe, 1980). The regional deformation and metamorphism can thus be considered to be of probable Late Silurian age, and related to Acadian orogenesis.

Rocks of the King George IV Lake complex are inhomogeneously deformed and are metamorphosed to the lower greenschist facies. They are juxtaposed against highly deformed and locally high grade metamorphic rocks and appear to be intruded by igneous rocks of the Lloyds River Intrusive Suite. The ophiolite is thus interpreted either to have been emplaced after the peak of regional metamorphism and deformation of the Bay du Nord Group, or to have been at a shallower tectonic level during the deformation and metamorphism. The ophiolite was already exposed and being eroded at the time of deposition of the unconformably overlying upper Lower Devonian Windsor Point Group. The deformation within the ophiolite (faulting, shearing and local folding) is probably correlative with the regionally developed structures in the Victoria Lake Group.

The latest deformations affected the Windsor Point Group and there is no upper limit on this deformation.

It is possible, therefore, that the entire sequence of tectonic events took place between the Middle Silurian and the Early Carboniferous.

MINERALIZATON

The most significant mineralization in the area is associated with the Victoria Lake Group and the granitic rocks of the Lloyds River Intrusive Suite (Unit 11) and Unit 16b. Except for minor pyrite and magnetite showings, no mineralization has been found in the other units, although the ophiolite rocks have a potential for Cyprus-type massive sulfides.

In the Victoria Lake Group, disseminated pyrite and minor chalcopyrite and sphalerite occur associated with the felsic volcanic rocks (Unit 6). Outside of the map area to the northeast, lead, zinc and copper mineralization form a number of subeconomic deposits, e.g. Tulks and Victoria Mines (Kean, 1979; Kean and Jayasinghe, 1980). These are stratiform volcanogenic massive sulfide associated with felsic pyroclastics. A similar potential may exist in the present map area, although the felsic pyroclastics are not extensive.

A boulder of highly altered green granite, similar to the marginal phase of subunit 11d, with galena-, sphalerite-, pyrite- and gold-bearing quartz veins was found in the stream of Princess Lake.* Galena-bearing stringers were also reported in streambed outcrops by Harvey (1930) while prospecting for the Anglo-Newfoundland Development Company Ltd.. This mineralization occurs along the contact between the Windsor Point Group and Unit 11 in an old fault zone related to the Cape Ray Fault. This zone can be extended southwest to the coast; significant gold mineralization northeast of Port aux Basques is associated with a subsidiary shear zone off the Cape Ray Fault within the Windsor Point Group and in quartz veins in the consanguineous Windowglass Hill Granite (Bucknell et al., 1980).

*Assays: 5% Zn, 1.5% Pb, 42 g/t Cu, 25 g/t Au (average of 5 assays), 8 g/t Ag.

Float of Unit 16b containing disseminated molybdenite was found west of Rocky Ridge Pond. Minor molybdenite was noted in the late, garnetiferous granite dikes and veins in the Buck Lake Quarry. Beryl was also noted in granite pegmatite float north of Burnt Pond Brook.

Veinlets of pyrite and chalcopyrite were seen in the granite-granodiorite immediately north of Burnt Pond Brook. Disseminated chalcopyrite and pyrite were found locally in the deformed conglomerate of Unit 9 along the Burgeo Road.

ACKNOWLEDGEMENTS

Jerome Cole, David Evans and Ralph Skinner are gratefully acknowledged for capable assistance in the field. Neil Jayasinghe was employed as a senior mapping assistant during the field season and is gratefully acknowledged for his invaluable assistance. Wayne Ryder, Sid Parsons, and Jim Barrett of the support staff of the Newfoundland Department of Mines and Energy provided capable field administration and logistical support. Doreen Peavy is kindly thanked for typing an early draft of this report. Scott Swinden, Ron Smyth and Sean O'Brien kindly reviewed the manuscript. The staff of the Publications and Information Section are thanked for their perseverance and patience in coping with the many changes in the text.

REFERENCES

Brown, P.A.
1973: Possible cryptic suture in southwest Newfoundland. Nature, Physical Science, Volume 245, Number 140, pages 9-10.

1975: Basement-cover relations in southwest Newfoundland. Unpublished Ph.D. thesis, Memorial University of Newfoundland, 221 pages.

1977: Geology of the Port aux Basques map area (110/10), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report, 77-2, 11 pages.

Bucknell, W.R., McKenzie, C.B., and Wilton, D.H.C.
1980: Geology of the Cape Ray Gold Deposit, Southwestern Newfoundland. Geological Association of Canada, Abstracts, Halifax, page 43.

Chorlton, L.B.
1978: La Poile River map area (110/16), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 78-168, with marginal notes.

1980a: Notes on the Geology of Peter Snout (11P/13, West half), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 80-201, with notes.

1980b: Geology of the La Poile River Area (110/16), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-3, 86 pages.

Cooper, J.R.
1954: The La Poile - Cinq Cerf map area, Newfoundland. Geological Survey of Canada, Memoir 276, 62 pages.

Dallmeyer, R.D.
1979: Geochronology - insular Newfoundland mapping, progress report 6/1/79 - 11/1/79. Canada-Newfoundland Mineral Development Subsidiary Agreement (1977-1982), Subproject 1-20, unpublished report, 57 pages.

1981: Geochronology - insular Newfoundland mapping, Progress report 9/1/80 - 8/31/81. Canada-Newfoundland Mineral Development Subsidiary Agreement (1977-1982),

Subproject 1-20, upublished report, 18 pages.

Dean, P.L.
1978: The volcanic stratigraphy and metallogeny of Notre Dame Bay, Newfoundland. Memorial University of Newfoundland, Geology Report 7, 204 pages.

DeGrace, J.R.
1973: Notes on the Geology of the King George IV Lake Area, southwest-central Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, unpublished report, 12 pages, Open Ffile 12A/4 (131).

Dickson, W.L. and MacLellan, H.E.
1981: Geology of Wolf Mountain (12A/2W) and Burnt Pond (12A/3E), Central Newfoundland. *In* Current Research. *Edited by* C.F. O'Driscoll and R.V. Gibbons. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-1, pages 96-102.

Dorf, E. and Cooper, J.R.
1943: Early Devonian plants from Newfoundland. Journal of Paleontology, Volume 17, pages 264-270.

Dunning, G.R. and Herd, R.K.
1980: The Annieopsquotch Ophiolite Complex, southwest Newfoundland, and its regional relationships. *In* Current Research, Geological Survey of Canadaaper 80-1A, pages 227-234.

Dunning, G.R. and Krogh, T.E.
1983: Tightly clustered, precise U/Pb (zircon) ages of ophiolites from the Newfoundland Appalachians. Geological Society of America, Abstracts, Northeast Section.

Erdtmann, B.D.
1976: Die Graptolithenfauna des Exploits Gruppe (Oberes Ordovizium, Caradoc) von Zentral newfoundland. Hamburg, Universitat, Geologisch-Palaontologisches Institut, Mitteilungen, Heft 45, s. 65-140.

Geological Survey of Canada
1968: Aeromagnetic Series Map, King George IV Lake, Newfoundland, Map 207G (Revised).

Harvey, G.
1930: Note to Anglo-Newfoundland Development Co. Ltd. on mineral prospects. Anglo-Nfld. Development Co., Ltd., unpublished memorandum, 1 page with sketch map.

Herd, R.K.
1978: Geology of Puddle Pond area, Red Indian Lake map-sheet, Newfoundland. *In* Current Research, Geological Survey of Canada, Paper 78-1A, Pages 195-197.

Herd, R.K., and Dunning, G.R.
1979: Geology of Puddle Pond map area, southwestern Newfoundland. In Current Research, Geological Survey of Canada, Paper 79-1A, pages 305-310.

Heyl, G.H.
1936: Geology and Mineral Deposits of the Bay of Exploits Area. Geological Survey of Newfoundland, Bulletin 3, 66 pages.

Higgins, M.W.
1971: Cataclastic Rocks. United States Geological Survey, Professional Paper 687, 97 pages.

Kean, B.F.
1976: Geology of the Victoria Lake map area, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 76-6.

1977: Geology of the Victoria Lake map area (12A/6), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 77-4, 11 pages.

1979: Star Lake map area, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 79-1.

Kean, B.F. and Jayasinghe, N.R.
1980: Geology of the Lake Ambrose (12A/10) - Noel Paul's Brook (12A/9) map areas, Central Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 80-2, 29 pages.

1982: Geology of the Badger map area (12A/16), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 81-2, 37 pages.

Kean, B.F., and Mercer N.L.
1981: Grand Falls map area (2D/13), Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 81-99, with marginal notes.

Mullins, J.
1961: Geology of the Noel Paul's Brook area, central Newfoundland. Unpublished M.Sc. thesis, Memorial University of Newfoundland, 96 pages.

Murray, R.C.
1955: Directions of glacier ice motion in south-central Newfoundland. Journal of Glaciology, Volume 63, pages 268-274.

Myashiro, A.
1973: Metamorphism and Metamorphic Belts. John Wiley and Sons, New York, 479 pages.

Ramsay, J.G.
1967: Folding and Fracturing of Rocks. McGraw-Hill Company, New York, 568 pages.

Riley, G.C.
1957: Red Indian Lake (west half), Newfoundland. Geological Survey of Canada, Map 8-1957 with descriptive notes.

Smyth, W.R.
1979: King George IV Lake, Newfoundland. Newfoundland Department of Mines and Energy, Mineral Development Division, Map 79-56.

Sterenberg, V.
1979: King George IV Lake sheet, Newfoundland. Hudson's Bay Oil and Gas Company Ltd., unpublished map.

Swanson, E.A.
1952-1960: Maps showing exploration in Crown Lands. ASARCO, unpublished report, Open File Nfld. 324.

Swinden, H.S.
1982: Time and space relationships of Lower - Middle Ordovician volcanism and massive sulphide deposition in the Newfoundland Central Mobile Belt. Geological Society of America, Abstract, Northeast Section.

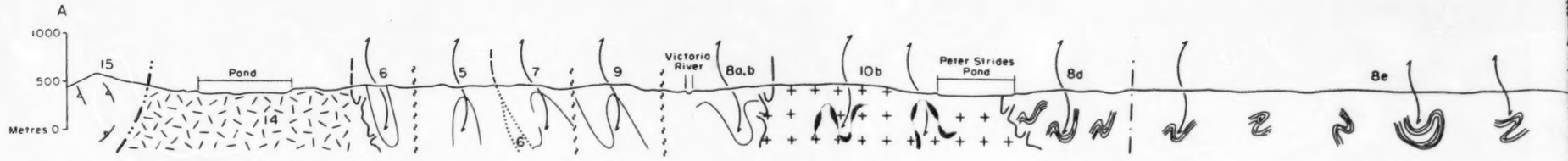
Williams, H.
1970: Red Indian Lake (east half), Newfoundland. Geological Survey of Canada, Map 1196A.

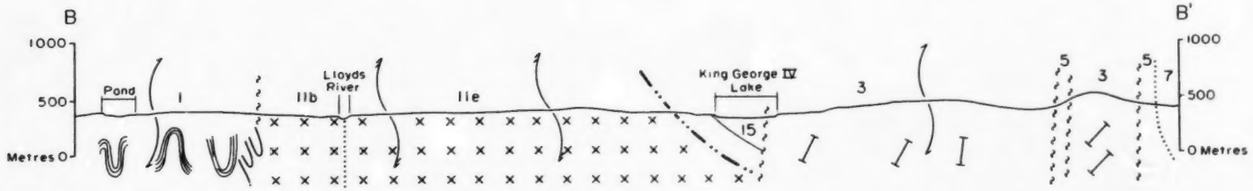
1978: Tectonic-lithofacies Map of the Appalachian Orogen. Memorial University of Newfoundland, Map Number 1.

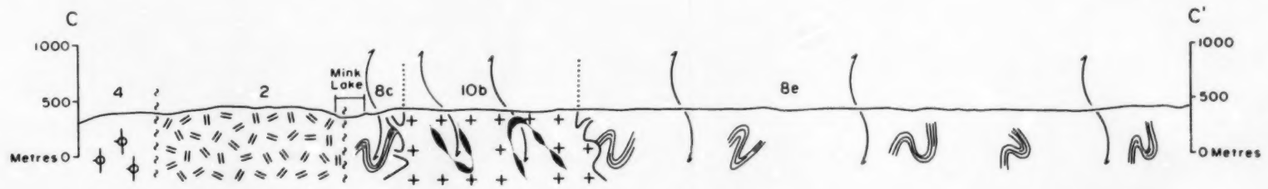
1979: Appalachian Orogen in Canada. Canadian Journal of Earth Sciences, Volume 16, pages 792 - 807.

Williams, H., Kennedy, M.J., and Neale, E.R.W.
1972: The Appalachian Structural Province. *In* Variations in Tectonic Styles in Canada. *Edited by* R.A. Price and R.J.W. Douglas. Geological Association of Canada, Special Paper 11, pages 181-261.

1974: The northeastward termination of the Appalachian Orogen. *In* The Ocean Basins and Margins. *Edited by* A.E.M. Nairn and F.G. Stehli, Volume 2, Plenum Press, New York, pages 79-123.







To accompany Map 82-51
King George IV Lake
Baxter Kean; Published 1983

Numbers refer to

Geologic boundar
assumed, gradatio

Unconformity (ap

Diagrammatic rep

Fault (approximat

Flow banding . . .

Sheeted dikes . . .

Pillow lava . . . . .

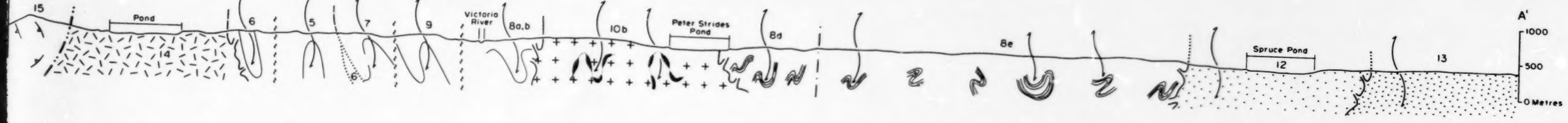
Gneissosity. . . . .

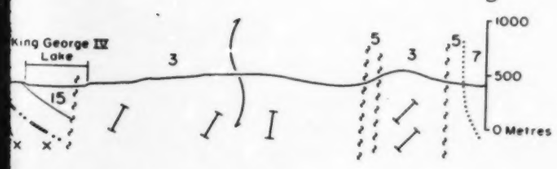
Cataclastic fabric.

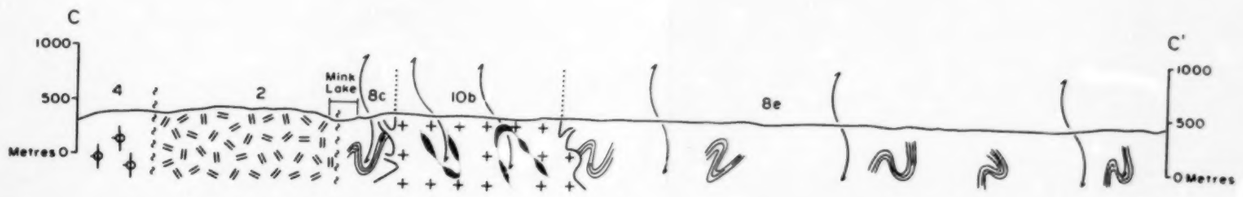
Regional foliation

Foliation of unspe

Horizontal and ver







LEGEND

Numbers refer to rock units and are the same as those in the map legend.

Geologic boundaries (surface expression defined, approximate, assumed, gradational)

Unconformity (approximate)

Diagrammatic representation of bedding

Fault (approximate, assumed)

Flow banding

Sheeted dikes

Pillow lava

Gneissosity

Cataclastic fabric

Regional foliation

Foliation of unspecified age

Horizontal and vertical scales 1:50,000